FREE Planet Poster

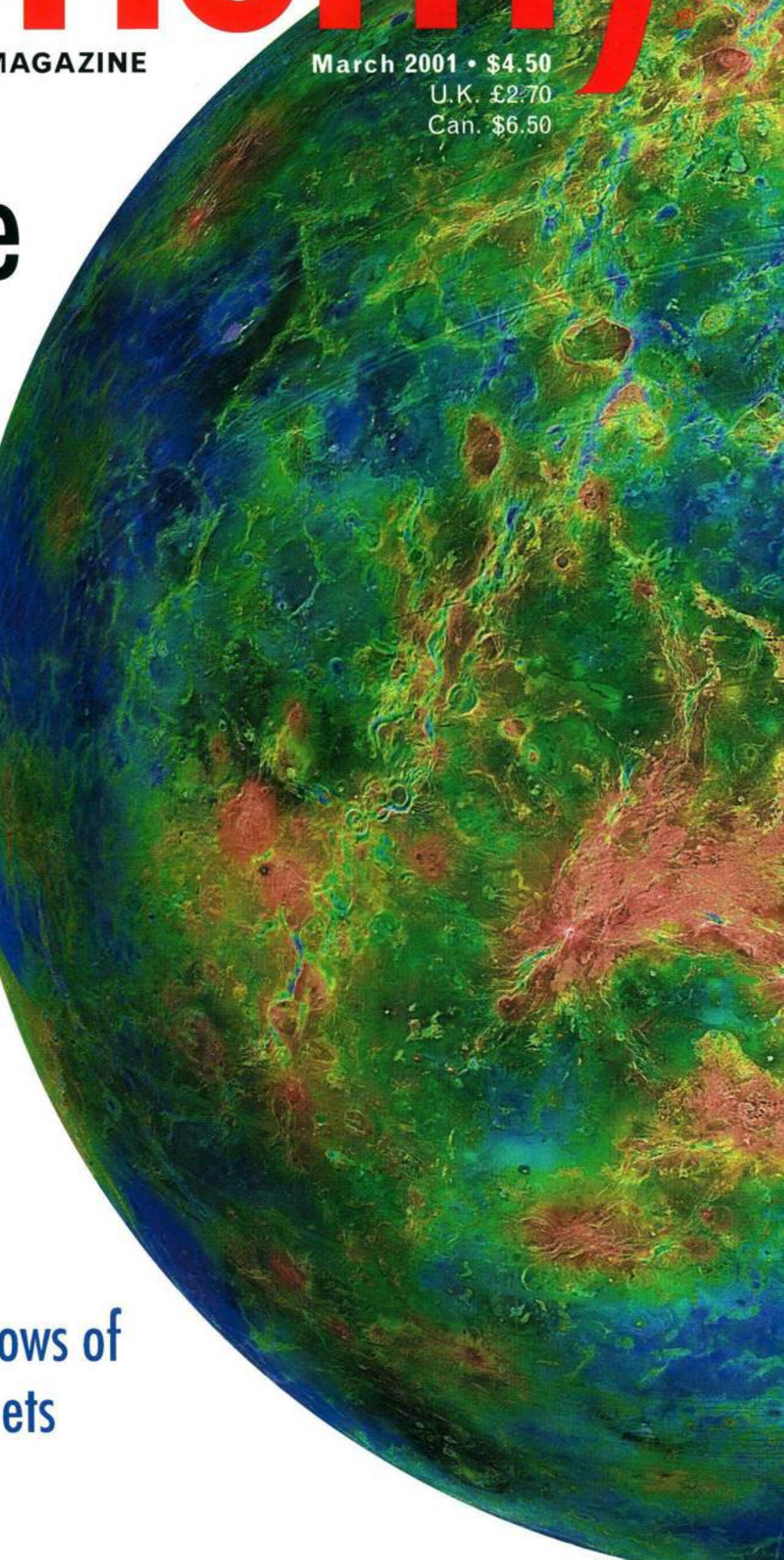
EXPOSING MARS'S ANCIENT LAKES

CMG 08070

Astronomy

AMERICA'S BEST-SELLING ASTRONOMY MAGAZINE

March 2001 • $4.50
U.K. £2.70
Can. $6.50



A Concise Guide to the Planets

Venus and Our Other Neighbors

Meteorite Hunters Discover Chunks of a Fireball

2 Hardworking Telescopes Put to the Test

Stalking Shadows of Earthlike Planets

astronomy.com

03>

0 75470 08070 8

Free LX10 Field Tripod!
Regularly $195, now free for a limited time!

LX10

MEADE LX10 EMC
MEADE
MEADE LX10
Meade

Meade 8" LX10 Schmidt-Cassegrain Telescope. Complete as shown with equatorial wedge and hand controller and, for a limited time, with *free* LX10 Field Tripod:

$995

Buy a Meade 8" LX10 Schmidt-Cassegrain telescope for $995 and, for a limited time, receive the $195 LX10 Field Tripod absolutely FREE!

For the serious amateur astronomer on a more limited budget, or for the more casual observer who nonetheless demands the very finest in optical performance, the Meade 8" LX10 satisfies every requirement. *Standard-equipment includes:*

Super-Multi-Coated Optical System: The *exact same* multi-coated 8" Schmidt-Cassegrain optical tube assembly as the more expensive Meade 8" LX200.

Series 4000 Super Plössl 26mm eyepiece: An $80 eyepiece, the SP26mm complements the exquisite imaging of Meade 8" Schmidt-Cassegrain optics.

Equatorial Fork Mounting: The relatively light weight, but very stable, LX10 fork mounting provides all of the rigidity required for sensitive high-power visual applications of the telescope, or for photographic or CCD imaging.

Cordless, DC-Powered Electronic Motor Drive: With electronically-regulated DC servo motor for automatic *sidereal-rate* tracking; powered for 50 hours by four AA-size batteries that fit conveniently into the telescope's control panel.

Worm-Gear System: The LX10's 5.75"-diameter worm gear produces extremely smooth, regular motion in R.A., with low periodic error — a periodic error that permits such advanced capabilities as long-exposure astrophotography or CCD imaging.

Hand Controller: Essential for micro-guiding the telescope in R.A. at 2x speed during long-exposure astrophotography. With the optional electric Declination motor *(see below)* added to the telescope, the hand controller is functional at 2x speeds on both telescope axes.

LX10 Field Tripod: The chromed steel LX10 Field Tripod provides an extremely rigid platform for visual and photographic observations with the telescope. Regularly $195, this tripod is included **free of charge** for a limited time with your purchase of the 8" LX10 telescope. *This free offer is valid from January 15, 2001 until further notice at participating dealers in the U.S.A.*

SPECIFICATIONS: 8" Model LX10 — Includes 8" Schmidt-Cassegrain optical tube assembly with EMC super multi-coatings (D = 203mm; F = 2000mm, f/10); fork mount with setting circles, manual slow-motion controls, and locks on both axes; 5.75" LX worm gear reduction system; sidereal-rate electronically-regulated DC servo motor drive; 4-pushbutton hand controller for 2x speed corrections in R.A.; battery compartment accepting four (user-supplied) AA-size batteries (telescope may also be powered from an auto cigarette lighter plug, using optional 25 ft. cord); 6 x 30mm viewfinder; eyepiece-holder and diagonal prism (1.25"); SP26mm multi-coated eyepiece; standard equatorial wedge with elevation scale, fine elevation control, and 360° azimuth orientation capability; LX10 Field Tripod (included only for a limited time, as noted above); complete operating instructions.
$995. (+ $65 packing & shipping in the 48 states)

Electric Declination Motor System for LX10. . . . . **95.**
#2014 Magellan I Telescope Computer System
for LX10 with 12,218-object database . . . . **375.**

Prices shown are suggested U.S. mail-order prices.

© 2001

AUTHORIZED MAIL-ORDER DEALERS

ASTRONOMICS, Norman, OK.
Orders: 800-422-7876; Info.: 405-364-0858.

FOCUS CAMERA, Brooklyn, NY.
Orders: 800-221-0828; Info.: 718-436-6262.

LUMICON, Livermore, CA.
Orders: 800-767-9576; Info.: 925-447-9570.

OCEANSIDE PHOTO & TELESCOPE, Oceanside, CA.
Orders & Information: 800-483-6287.

POCONO MOUNTAIN OPTICS, Moscow, PA.
Orders: 800-569-4323; Info.: 570-842-1500.

RIVERS CAMERA, Dover, NH.
Orders: 800-245-7963; Info.: 603-742-4888.

SHUTAN CAMERA & VIDEO, Chicago, IL.
Orders & Info.: 800-621-2248; IL: 847-367-4600.

EFSTONSCIENCE, Toronto, Ontario, Canada
Orders & Information: 416-787-4581.

KHAN SCOPE CENTRE, Toronto, Ontario, Canada
Orders & Information: 416-783-4140.

MEADE

LX200

The largest-selling serious telescopes in the world are now available at the most affordable prices *ever!*

With their large object databases, fast slewing speeds, and uncanny pointing precision, Meade LX200's are recommended for those amateurs who intend an extensive program of CCD imaging, astrophotography, or deep-space observing. Compare a Meade LX200 feature-for-feature with competing single-tine-fork, spur-gear-driven, GO TO Schmidt-Cassegrains:

Superb Optics: With oversize primary mirrors for greater full-field illumination, LX200 diffraction-limited imaging capabilities are a legend in the industry; we regularly receive reports stating that optical performance approaches that of a fine *ED* apochromatic lens.

Automatic GO TO Capability: Competing 8" Schmidt-Cassegrains claim to place objects "somewhere in the field of view"; Meade LX200's place objects **dead-center** in the field of view, first time, every time, to a pointing precision of **2 arc-minutes or better,** or, with Meade exclusive High Precision Pointing, to a precision of **one arc-minute or better.** *Meade LX200's are the only commercial telescopes ever manufactured that automatically GO TO any input R.A. and Dec., or to any object in the onboard database, to these levels of precision.*

Database of 64,359 Objects, a database *more than three times larger* than competing GO TO telescopes.

Permanently-Programmable Smart Drive™ routinely achieves 5 arc-sec. periodic error, an observatory standard. Other brands of GO TO 8" SCT's decline to state their periodic error and do not offer any programmable error-corrector.

9-Speed Dual-Axis Electronics: Electronics that cover every contingency of telescope positioning — from 2x photo-guide, to 32x image centering, to 8°/sec. slewing across the sky, plus 6 other dual-axis drive speeds in between.

Rigid LX200 Dual-Tine Fork Mountings with Dual 5.75" Worm Gears are the choice of advanced observers, CCD imagers, and astrophotographers for their most sensitive applications. Competing spur-gear-driven single-tine forks can not approach the strength, rigidity, and drive-rate precision built into every Meade LX200 mounting.

Full Long-Exposure Capability: Competing 8" GO TO telescopes describe their capability to take short-exposure "planetary and terrestrial photos," without reference to any long-exposure capabilities. Meade LX200's have been the instruments of choice in **thousands** of the most detailed long-exposure images ever taken by amateur astronomers.

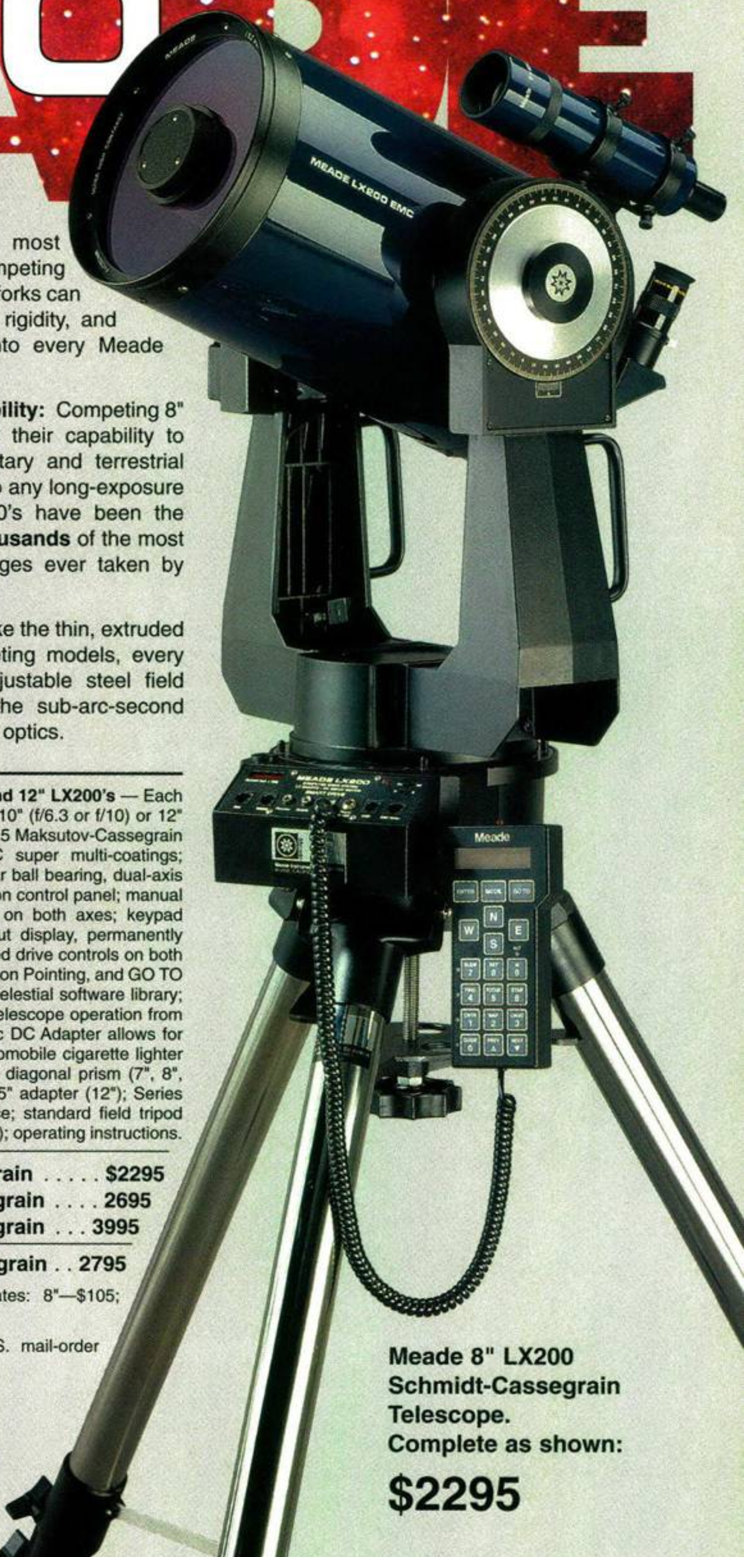
Strong Field Tripods: Unlike the thin, extruded aluminum tripods of competing models, every LX200 includes a fully adjustable steel field tripod perfectly suited to the sub-arc-second resolution of the telescope's optics.

SPECIFICATIONS: 7", 8", 10", and 12" LX200's — Each complete telescope includes 8" or 10" (f/6.3 or f/10) or 12" f/10 Schmidt-Cassegrain or 7" f/15 Maksutov-Cassegrain optical tube assembly with EMC super multi-coatings; heavy-duty fork mount with 4" polar ball bearing, dual-axis 5.75" worm gears, and multi-function control panel; manual and electric slow-motion controls on both axes; keypad hand controller with digital readout display, permanently programmable Smart Drive, 9-speed drive controls on both axes (7-speed on 12"), High-Precision Pointing, and GO TO controller; 64,359-object onboard celestial software library; 25 ft. power cord and adapter for telescope operation from 115v.AC (optional #1812 Electronic DC Adapter allows for field powering directly from an automobile cigarette lighter plug); 8 x 50mm viewfinder; 1.25" diagonal prism (7", 8", 10") or 2" diagonal mirror with 1.25" adapter (12"); Series 4000 Super Plössl 26mm eyepiece; standard field tripod (7", 8", 10") or giant field tripod (12"); operating instructions.

8" LX200 Schmidt-Cassegrain	**$2295**
10" LX200 Schmidt-Cassegrain	**2695**
12" LX200 Schmidt-Cassegrain	**3995**
7" LX200 Maksutov-Cassegrain	**2795**

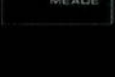
Packing and shipping in the 48 states: 8"—$105; 10"—$145; 12"—$215; 7"—$125.

Prices shown are suggested U.S. mail-order retail prices.



Meade 8" LX200 Schmidt-Cassegrain Telescope. Complete as shown:

$2295



New 2000-2001 126-page Meade General Catalog!

Call, write or fax for your free copy.

ADVANCED PRODUCTS DIVISION

Meade Instruments Corporation

World's Leading Manufacturer of Astronomical Telescopes for the Serious Amateur

6001 Oak Canyon, Irvine, California 92618 ■ (949) 451-1450
FAX: (949) 451-1460 ■ *www.meade.com*

© 2000

March 2001 • Vol. 29, No. 3

Astronomy®

COVER PHOTO: NASA

FEATURES

38 **Discovering Worlds in Transit**
Searching for subtle dips in brightness is all the rage among astronomers seeking Earthlike planets beyond the solar system. *Laurance R. Doyle, Hans-Jörg Deeg, and Jon M. Jenkins*

44 **A NEAR Look at Eros**
As the NEAR spacecraft completes its year-long survey of the boulder-strewn Eros, it helps solidify the link between asteroids and meteorites. *Rex Graham*

48 **In Search of Fresh Fall**
The June 1998 blasts that ripped the air above a parched New Mexico landscape set off a frenzy among amateur and professional meteorite hunters. *Tom Yulsman*

54 **Is Earth Unique?**
Most astronomers and biologists believe life exists elsewhere in the universe but, so far at least, we are it. *Martin Rees*

COVER

59 **Home Sweet Spheres**
Big and small, hot and cold — our solar system's nine planets run the gamut of possibilities. *Samantha Beres*

76 **Big Scopes Go Nose to Nose**
If razor-sharp images of planets and bright deep-sky objects are your cup of tea, check out the new high-end refractors from TeleVue and Vixen. *Rod Pommier*

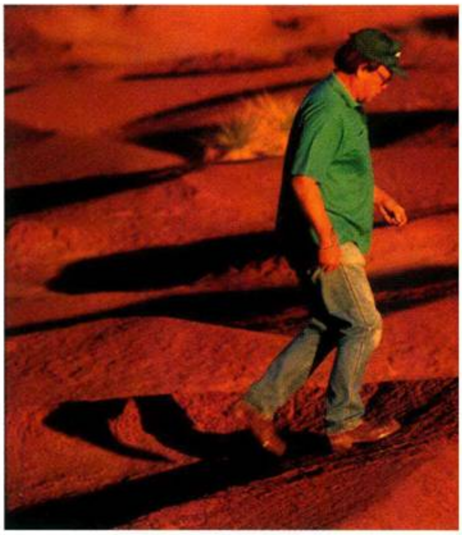
82 **Is the Universe Irish?**
Lots of people like to wear the green for one of March's favorite celebrations, but to the cosmos every day is Saint Patrick's Day. *Bob Berman*

20 AstroNews

H. Ebeling, et al.

54 Is Earth Unique?

Carol Ryback



44 A NEAR Look at Eros

Johns Hopkins University and NASA

DEPARTMENTS

76 Two Telescopes Put to the Test

Astronomy: William Zuback

6 Behind the Scenes
- Evolution at *Astronomy*

14 Talking Back

20 AstroNews
- Mars Geology Grows More Intriguing
- Twin Asteroid Discovered
- Black Holes Act as Midwives
- The Fall of Cold Dark Matter?
- Survey Finds Huge Clusters
- Seeing Red on Mount Graham
- Closeup on Distant Giants
- Edge of the Solar System

64 Sky Show
- While Venus plunges out of view, Jupiter and Saturn take over the evening sky and Mars grows prominent before dawn. *Martin Ratcliffe and Alister Ling*

86 Ask Astro

90 Strange Universe

94 Star Stuff

Products
- AstroCam
- Sky/View Astro Observatory
- Gibeon Meteorite
- Crazy ThermaBand

Books
- *Between the Lines: The Mystery of the Giant Ground Drawings of Ancient Nasca, Peru*
- *Challenge to Apollo: The Soviet Union and the Space Race, 1945–1974*
- *Asteroids: A History*

Media
- Final Frontier
- The Mystery of Chaco Canyon

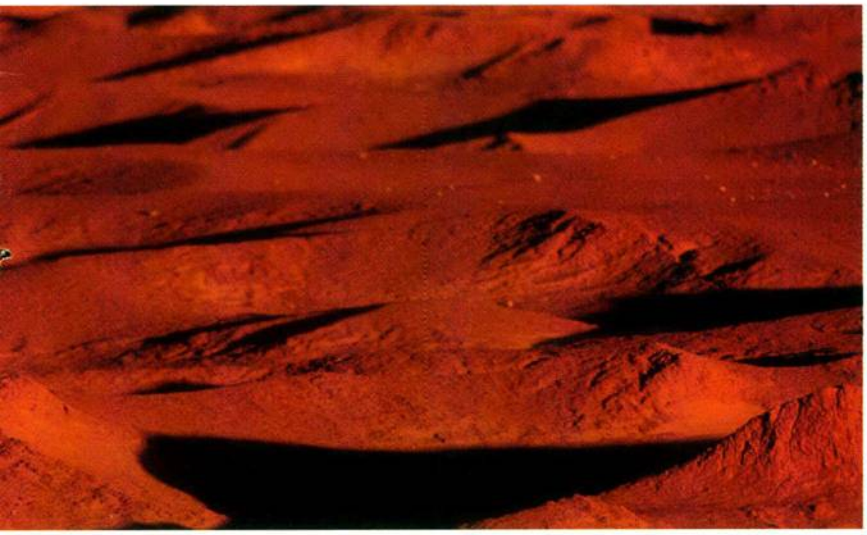
112 Looking Ahead

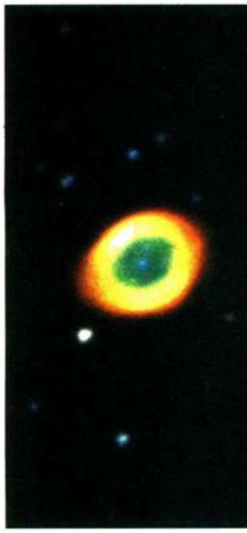
113 Advertiser Index

114 Hot Shots
- Finding Camp Astronomy

120 Ultimate Exposure

48 Meteorite Hunters Discover Fireball Chunks Will Van Overbeek





82 Is the Universe Irish? John Chumack

38 Stalking Shadows of Earthlike Planets Lynette R. Cook

BEHIND THE SCENES

BY BONNIE BILYEU GORDON

Evolution at *Astronomy*

Recently, David Letterman has been trying to convince viewers to help him bring down the International Space Station. He heard that once it's fully functional, the station will be the third brightest object in the night sky. He feels that we have done fine without that particular bright light for at least a million years, and he doesn't like the change. As big fans of space science missions, many of which have been delayed or cancelled in favor of the space station, the editors of *Astronomy* sympathize with Mr. Letterman. In fact, we're taking a more careful look at him. Perhaps he'd like to join our staff as a contributing editor.

William Zuback

William Schomaker

The magazine has been enjoying some staff growth and change. We have promoted staff members and added new ones, and we need to share the news, some of it tardy. In November, associate editor Rich Talcott, who has been a central force in this magazine for 15 years, was promoted to senior editor. Rich, a diligent and talented editor and writer, knows almost everything and has high standards without being noisy about them. I give him a lot to do and then I give him more, and he does it all well.

William Zuback

Elesa Janke

In the same month, Kelly Kizer Whitt moved from the copy editor position to assistant editor, a promotion she too richly deserves. In fact, she has long been commissioning, editing, and writing stories in addition to serving as copy editor. As photo editor during the past year, she has made this magazine more beautiful than it ever was before. To top all this, she gave birth to a baby boy, Kaden Kizer Whitt, on Thanksgiving Day (but by then, she'd already been promoted).

Paul Morse/CORBIS

David Letterman

We have a new associate editor, who is taking over the work that Andrea Gianopoulos used to do. She has become editor of our much-enlarged website Astronomy.com and has been replaced at the magazine by William Schomaker, who joined us during the summer as a part-time intern. We liked him well enough to hire him permanently as an associate editor, and every day that decision becomes wiser. He has recently finished his course work for a Master's Degree in astronomy at the University of Wisconsin. He lives in Madison, Wisconsin, (which means he drives 70 miles to work each day) with his wife, Heather, and their two cats.

We also have a new copy editor, Elesa Janke, who replaces Kelly in that role. Elesa recently was graduated from the University of Wisconsin at Whitewater with a degree in English. She interned at *Wisconsin Trails* magazine, while studying and working as a writing tutor.

There may be room on our editorial advisory board for one more advisor. What do you say, Dave?

And for lots of news on Cassini and Mars, turn to page 26.

Astronomy®

EDITORIAL STAFF

EDITOR
Bonnie Bilyeu Gordon
MANAGING EDITOR
David J. Eicher
SENIOR EDITORS
Rex Graham, Richard Talcott
ASSOCIATE EDITORS
Carol Ryback, William Schomaker
COPY EDITOR
Elesa Janke
PHOTO EDITOR
Kelly Kizer Whitt
EDITORIAL ASSOCIATE
Terry Williams Conley
EDITORIAL ASSISTANT
Julie Sherwin
CONTRIBUTING EDITORS
Robert Irion, Ray Jayawardhana, Patricia Kurtz, Beth Livermore, John Shibley, Tom Yulsman

ART STAFF

ART DIRECTOR
Carole Ross
ASSISTANT ART DIRECTOR
Thomas Ford
GRAPHIC ARTIST
Beth Wesselhoff
ILLUSTRATOR
Elisabeth Rowan
PRODUCTION COORDINATOR
Helene Tsigistras

EDITORIAL ADVISORY BOARD

Buzz Aldrin, Marcia Bartusiak, K.C. Cole, Timothy Ferris, Adam Frank, Paul Hodge, John S. Gallagher III, Anne L. Kinney, Edward Kolb, Alan Lightman, Stephen P. Maran, Boyce Rensberger, James Trefil

ASTRONOMY.COM EDITOR

Andrea Gianopoulos

Astronomy HOME PAGE The Audit Bureau

http://www.astronomy.com

Astronomy (ISSN 0091-6358, USPS 531-350) is published monthly by Kalmbach Publishing Co., 21027 Crossroads Circle, P.O. Box 1612, Waukesha, WI 53187. Editorial phone: (262) 796-8776; advertising: (888) 558-1544; customer service & sales: 800-533-6644; outside the U.S. and Canada: 262-796-8776, ext. 421, Monday through Friday, 8:30 A.M. to 5 P.M. CT, Fax: (262) 796-1615; E-mail: customerservice@kalmbach.com. Please include your name, mailing address, and telephone number with any correspondence. Copyright © 2001 Kalmbach Publishing Co., all rights reserved. Material in this publication may not be reproduced in any form without permission. Periodicals postage paid at Waukesha, WI, and additional offices. Printed in the U.S.A. Allow 6 to 8 weeks for new subscriptions and address changes. Subscription rate: single copy: $4.50; 1 year $39.95, 2 years (24 issues) $74.95, 3 years (36 issues) $106.95; Canadian & foreign: 1 year $50, 2 years $95, 3 years $137. Payable in U.S. funds drawn on U.S. Banks. *(Canadian price includes GST.)* Expedited Delivery Service Surcharges: Domestic 1st Class $30 per year, Canadian air $30 per year, Foreign air, $60 per year. BN 12271 3209 RT. Canada Post Publication Agreement Number 545-775. Not responsible for unsolicited materials. POSTMASTER: Send address changes to *Astronomy*, 21027 Crossroads Circle, P.O. Box 1612, Waukesha, WI 53187-1612.

NEW!

MEADE

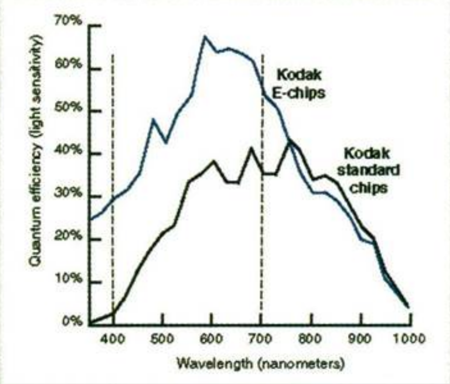
PICTOR XTE IMAGING SYSTEMS

How to cut all of your CCD exposure times in half!

New Meade Pictor 416XTE and 1616XTE imaging systems include the revolutionary Kodak E-Series of blue-sensitive CCD chips, permitting dramatically improved imager performance. With *twice* the overall light sensitivity and *four to ten times* the blue-light sensitivity of previous Kodak KAF-0400 and KAF-1600 chips *(see graph below)*, the E-chips incorporated into Meade XTE-series imagers nonetheless maintain the previous chips' low readout noise and dark current characteristics, as well as their high-resolution 9.0-micron-square pixel dimensions.

All Meade Pictor CCD models are fully compatible with the 32-bit operating platforms of Windows 95, 98, and NT, enabling fast, stable, smoothly-running program operation.

Use a Meade XTE-Series imager on your 6", or larger, telescope and obtain imaging results that match or exceed the photographic results of many observatory telescopes. And, notwithstanding the enormous data-collection power of Pictor 416XTE and 1616XTE imagers, each system's standard-equipment SCSI interface enables full-frame download to the host computer in *seconds,* permitting virtually real-time object acquisition, focusing, and centering. On-board programs include automatic exposure level, dark current exposure, and flat-field sequence, in addition to pixel binning.



Kodak E-chips used in Meade XTE imagers result in greatly increased light sensitivity. In this graph the region of visible wavelengths (400nm. to 700nm.) is indicated by dotted lines.

Meade Pictor 416XTE and 1616XTE models are a revelation of high-speed imaging performance on telescopes of all types and apertures. Applied to Meade LX200 Schmidt-Cassegrain telescopes, imager operation and performance are extended still further, with advanced features such as Autocentering, Autofocus, and Automosaicking.

The Meade Pictor 416XTE imaging system, shown with #778 Off-Axis Guider, Image-Orientation Adapter, and Pictor 201XT Autoguider.

The Meade CCD Equipment System, provided at no additional charge with every Pictor 416XTE and 1616XTE, includes essentially all hardware and software required for advanced CCD imaging applications: **Pictor 201XT Autoguider,** for automatic guiding of the CCD camera during long-exposure imaging; **#778 Off-Axis Guider,** with adapters for use with either Schmidt-Cassegrain telescopes or with standard 1.25" eyepiece-holders; **CCD Image-Orientation Adapter** for precise orientation of the image on the CCD chip; and **Meade Epoch 2000ip Image Processing Software,** professional Windows-based image processing for the enhancement and analysis of CCD images — all packed in a foam-lined carrying case that provides for secure storage of the CCD camera and all items of the CCD Equipment System.

The Meade CCD Equipment System is included as standard-equipment with Pictor 416XTE and 1616XTE imagers.

Optimized Tricolor Imaging with the New Pictor 616 Color Filter System

Recent performance improvements in the Meade Pictor 616 Color Filter System are as remarkable and dramatic as advancements in Meade XTE imagers. The new tricolor filter set includes red, green, blue, and clear filters with CAD-optimized multi-layer dielectric interference coatings deposited on optical-flat substrates, permitting extremely sharp filter bandpasses and improved color balance. Filter transmissions exceed 90%, a more than 35% improvement, while simultaneously providing complete (< 1%) out-of-band blocking across the entire spectral sensitivity range of Kodak E-series CCD's.

Meade Pictor 616 Color Filter System *(left)*, shown attached to Pictor 416XTE Imager.

MEADE XTE IMAGING SYSTEMS

Pictor 416XTE (16-bit), with Meade CCD Equipment System	**$1995**
Pictor 1616XTE (16-bit) with Meade CCD Equipment System	**6495**
Pictor 616 Color Filter System, for use with Pictor 416XTE, 1616XTE	**695**

For complete information on Meade CCD imaging systems, write, call, or fax for your free copy of the 126-page Meade General Catalog.

© 2001

Free
#882 Field Tripod!
Regularly $99, now *free* for a limited time

Now you can join the ETX revolution for as little as $299, complete!

MEADE
ETX-60AT • ETX-70AT

Let Meade high-resolution ETX optics and standard-equipment Autostar controller take you on an automated guided tour of the Solar System, the Galaxy, and beyond.

Fork Mount with Dual-Axis Drive System: Precision worm gear systems permit smooth pushbutton motions of the telescope, as well as sidereal-rate tracking in the altazimuth mode.

Free #882 Field Tripod!

For a limited time you can purchase a Meade ETX-60AT or ETX-70AT Astro Telescope and receive a full-length Meade #882 Standard Field Tripod (regularly $99), **absolutely free.** The #882 Tripod is ideal for either seated or standing observations through the telescope. *This offer is valid from January 15, 2001, until further notice, at participating Meade dealers in the U.S.A.*

Standard-Equipment #494 Autostar™ Controller: Includes most of the same features as the more advanced #497 Autostar available for larger ETX models *(facing page).*

- **Automatic dual-axis GO TO function at 4.5°/sec.** to any of more than 1450 database objects, including the complete Messier and Caldwell deep-space object catalogs, the major planets from Mercury to Neptune, 26 asteroids, 15 periodic comets, and more. Or GO TO *any* object of known R.A. and Dec.
- **9-speed Dual-Axis Operation:** Pushbutton control of the telescope on both axes, simultaneously, at any speed from 2x sidereal to 4.5°/sec., plus sidereal-rate tracking.

High-Resolution Achromatic Objective Lenses of exclusive Meade design; each lens yields razor-sharp images of astronomical and terrestrial subjects.

Flip-Mirror System: Flip the internal optical flat mirror "up" for 90° observing; flip the mirror "down" for terrestrial observing with the optional #933 45° Erecting Prism or for photography with the optional #64ST Photo Adapter.

Cordless Operation: The dual-axis drive operates for over 20 hours in the field from six AA-size (user-supplied) batteries which store neatly inside the drive base.

Solar System:
Saturn
ENTER
MODE
GO TO
SPEED
MEADE
AUTOSTAR
Guided Tour
Tonight's Best
ENTER
MODE
GO TO
SPEED
MEADE
AUTOSTAR
MEADE
COMPUTER CONTROL
ON
OFF
AUX

ETX-70AT: $349, complete with #494 Autostar Controller and #882 Standard Field Tripod

ETX-60AT: $299, complete with #494 Autostar Controller and #882 Standard Field Tripod

SPECIFICATIONS: ETX-60AT and ETX-70AT Astro Telescopes — Each includes achromatic refractor optical tube assembly (D = 60mm, F = 350mm, f/5.8 *or* D = 70mm, F = 350mm, f/5) with multi-layer optical coatings; internal flip-mirror system for either straight-through or 90° observing position; fork mount with electric slow-motion controls, setting circles, and locks on both axes; electronic control panel; 9-speed (2x sidereal through 4.5°/sec.) dual-axis motor drive system with #494 Autostar computer controller; sidereal-rate tracking; internal compartment accepting six (user-supplied) AA-size batteries; MA9mm (39X) and MA25mm (14X) multi-coated eyepieces; #882 Standard Field Tripod (included only for a limited time, as noted above); operating instructions. **ETX-60AT — $299** (+$10 packing & shipping in the 48 states); **ETX-70AT — $349** (+$10 P & S).

OPTIONAL SYSTEMS FOR MEADE ETX TELESCOPES*

#882 Standard Field Tripod (60, 70)	$99.00	#883 Deluxe Field Tripod (90, 125)	199.95
#827 8 x 25mm Right-Angle Viewfinder (60, 70)	49.95	#825 8 x 25mm Right-Angle Viewfinder (90)	49.95
#773 Hard Carry Case (60, 70)	59.95	#774 Hard Carry Case (90)	99.95
#933 45° Erecting Prism (60, 70)	49.95	#775 Hard Carry Case (125)	149.95
#64ST Photo Adapter (60, 70)	19.95	#932 45° Erecting Prism (90, 125)	49.95
#497 Autostar Computer Controller (90, 125)	149.00	#64 Photo Adapter (90, 125)	34.95
#880 Equatorial Table Tripod (90)	29.95	Electric Focuser #1244 (90) *or* #1247 (125)	119.95
#881 Equatorial Table Tripod (125)	59.95		

**see also the Meade accessory ad in this issue.*

MEADE INSTRUMENTS CORPORATION *The largest-selling telescopes in the world.*

ETX-90EC • ETX-125EC

ETX-90EC:
$495, complete with Electronic Controller
ETX-125EC:
$895, complete with Electronic Controller
COMPUTER CONTROL
MEADE

Save up to $150!
ETX-90EC now $495
Autostar $99 for a limited time!

Meade® 3.5" and 5" ETX® models include the very latest in microprocessor-controlled capability:

Fork Mount with Dual-Axis Drive System: Each with high-torque DC motors on both telescope axes, permitting electronic operation from the standard-equipment plug-in hand controller.

Pushbutton Electronic Hand Controller: Use any of four dual-axis speeds: 8x for image centering at high power; 32x for image centering at lower power; 0.75°/sec for image centering in the viewfinder or for terrestrial tracking; 5°/sec for fast slewing across the sky.

Maksutov-Cassegrain Optical Systems: Manufactured at the Meade Irvine, facility, ETX diffraction-limited optics produce images so high in contrast and resolution that ETX telescopes often outperform other telescopes of larger apertures.

Flip-Mirror System: Flip the internal optical flat mirror "up" for 90° observing; flip the mirror "down" for terrestrial observing with the optional #932 45° Erecting Prism or for photography with the optional #64 Photo Adapter.

Cordless Operation: The dual-axis drive system operates for more than 40 hours from eight (user-supplied) AA batteries which store neatly inside the drive base.

Special Offer: ETX-90EC now $495!

Now for a limited time you can purchase the Meade ETX-90EC Astro Telescope — the largest-selling modern telescope in the world — at $495, a savings of $100 off the regular price. *This offer is valid from January 15, 2001, until further notice, at participating Meade dealers in the U.S.A.*

Optional #497 Autostar™ Now Only $99 (regularly $149) For a Limited Time! Plug in the optional Meade #497 Autostar computer controller for LX200-type operation, including:

- **Automatic dual-axis GO TO function at 5°/sec** to any of more than 14,000 database objects, including thousands of deep-space objects; the 8 major planets from Mercury to Pluto; 26 of the brightest asteroids; 15 periodic comets; and more.
- Select any of Autostar's database objects, or any object of known R.A. and Dec, press ***GO TO*** and the telescope automatically slews to the object.
- **9-Speed Dual-Axis Operation:** Pushbutton control of the telescope on both axes, simultaneously, at any speed from 2x sidereal to 5°/sec., plus sidereal-rate tracking.

ETX AUTOSTAR
MEADE
ENTER
MODE
GO TO

SPECIFICATIONS: ETX 90EC and ETX-125EC Astro Telescopes — Each includes Maksutov-Cassegrain optical tube assembly (D = 90mm, F = 1250mm, f/13.8 *or* D = 127mm, F = 1900mm, f/15) with EMC super multi-coatings; internal flip-mirror system for either straight-through or 90° observing position; fork mount with electric slow-motion controls, setting circles and locks on both axes; electronic control panel; 4-speed (8x, 32x, 0.75°/sec, 5°/sec) dual-axis motor drive system with hand controller; sidereal-rate tracking in equatorial mode with optional table tripod or deluxe field tripod; internal battery compartment accepting eight (user-supplied) AA-size batteries; 8 x 21mm erect-image (ETX-90EC) *or* 8 x 25mm right-angle (ETX-125EC) viewfinder; Series 4000 Super Plössl 26mm eyepiece (1.25"); instructions. **ETX-90EC — $495** (+ $20 packing & shipping in the 48 states); **ETX-125EC — $895** (+ $30 P & S).

AUTHORIZED U.S. AND CANADA MAIL-ORDER DEALERS

ASTRONOMICS, Norman, OK.
Orders: 800-422-7876; Info.: 405-364-0858.

FOCUS CAMERA, Brooklyn, NY.
Orders: 800-221-0828; Info.: 718-436-6262.

LUMICON, Livermore, CA.
Orders: 800-767-9576; Info.: 925-447-9570.

OCEANSIDE PHOTO & TELESCOPE, Oceanside, CA.
Orders & Information: 800-483-6287.

POCONO MOUNTAIN OPTICS, Moscow, PA.
Orders: 800-569-4323; Info.: 570-842-1500.

RIVERS CAMERA, Dover, NH.
Orders: 800-245-7963; Info.: 603-742-4888.

SHUTAN CAMERA & VIDEO, Chicago, IL.
Orders & Info.: 800-621-2248; IL: 847-367-4600.

KHAN SCOPE CENTRE, Toronto, Ontario.
Orders & Information: 416-783-4140.

6001 Oak Canyon, Irvine, CA 92618. (949) 451-1450. FAX: (949) 451-1460. www.meade.com

© 2001

MEADE RESEARCH-GRADE ACCESSORIES

Series 4000™ Super Plössls 52° field; multi-coated

Meade 4-element Super Plössls, updated and redesigned to utilize the latest in optical glass-types, are the finest general-purpose eyepieces available. For observing hairline lunar and planetary detail, splitting close doubles, or for deep-space; guaranteed to deliver more contrast and image sharpness than any other brand. Rubber eyeguards fold down for eyeglass wearers–a feature not available on competing brands. Multi-coated. All focal lengths through 32mm are parfocal.

Super Plössls (SP; 4-elements; 1.25"; 52°):

6.4, 9.7, 12.4, 15, 20, 26mm	each:	**$79.95** (4.54)
32mm (52°); **40mm** (44°)	each:	**99.95** (5.26)
56mm (52°; 2")		**199.95** (7.02)

Series 4000™ Ultra Wide Angle 84° field; multi-coated

The ultimate eyepieces; extreme image sharpness over an amazing 84° field. A perfect optical match with Schmidt-Cassegrains and fast Newtonians.

Ultra Wide Angle (UWA; 8-elements; 1.25"; 84°)– **4.7mm: $169.95** (5.26); **6.7mm: 199.95** (5.26); **8.8mm** (1.25"/2"): ***239.95*** (7.02); **14mm** (1.25"/2"): **299.95** (7.02)

Series 4000™ f/6.3 Focal Reducer/ Field Flattener

Manufactured to exclusive Meade optical designs; threads on to any Meade or Celestron Schmidt-Cassegrain rear cell and converts f/10 scopes to f/6.3 (or f/6.3 SCT's to f/4), while significantly flattening the field. Use with SCT visual or photo accessories. Actual visual field is increased by 56%, for fine wide-field views of star fields and nebulae. In astrophotography, reduces exposure times by about 50%, while producing an actual field diameter of 1.5" at the film plane. A tremendous aid with CCD imagers in reducing image size for locating and centering images on CCD chips. 4-element optics; multi-coated; 41mm clear aperture. **$129.95** (5.26)

2x Telenegative Barlow (1.25")

#122: Doubles eyepiece power with sharp, high-resolution, high-contrast imaging on telescopes of all types. 27mm dia. (26mm clear aperture). Excellent corrections for chromatic and spherical aberrations at all photo-visual wavelengths. Multi-coated. 1.25"

$47.95 (4.54)

2x Short-Focus Barlow (1.25")

#126: Only 2.5" long, the #126 works well with any telescope accepting 1.25" eyepieces, even those with limited focus range. Maintains the high image quality of the #122, above. Insert the #126 into star diagonal for 2x or insert star diagonal into #126 for 3x. 26mm clear aperture. Multi-coated. **$47.95** (4.54)

2x-3x Variable Barlow (1.25")

#127: Precision internal sliding lens assembly permits continuously variable power settings between 2x and 3x. Engraved scale indicates power in use. Yields bright, sharp, high-contrast images on telescopes of all types. Multi-coated; 1.25".

$59.95 (4.54)

2" Diagonal Mirror

#929: Permits use of wide-field 2" oculars. Threads on to rear cell of Meade and Celestron SCT's. Includes multi-coated precision optical flat made at the Meade factory; with 1.25" eyepiece adapter. **#930:** Same as #929 but with 2" barrel to fit into focusers with 2" eyepiece-holders.

#929 or **#930,** each: **$99.95** (6.85)

45° Erecting Prisms

Fully coated roof prisms to invert the astronomical image in Schmidt-Cassegrains or refractors during terrestrial observations, while presenting a convenient 45° observing angle. Specify **#927** (.965"), **#928** (1.25"), or **#931** (fits .965" focuser, accepts 1.25" eyepieces).

$42.95 (3.86)

World's Most Advanced Illuminated Reticle Eyepiece

Series 4000 Plössl 9mm, with rubber eyecup and micrometric X-Y positioning of the reticle within the field. Greatly facilitates locking on the guide star. Sharp high-power imaging, excellent eye relief. Wireless red LED illuminator with adjustable brightness control. Multi-coated optics. **Internal batteries included.** Bullseye reticle. 1.25".

$149.95 (6.14)

Series 4000 Plössl 9mm—Same as above but with 6 ft. cord and plug for Meade LX3, LX5, LX6, LX100, LX200, and APO power panels, in place of wireless illuminator.

$129.95 (5.26)

Series 4000 Photo-Visual Color Filters (1.25")–Premium filters, made of purest crown optical glass, dyed in the mass. For increased contrast and resolution on the Moon and planets. Thread into the barrels of virtually all 1.25" eyepieces sold today. Fully coated.

#8 Lt. Yellow; #11 Yellow Green; #12 Yellow; #21 Orange; #23A Lt. Red; #25A Red; #38A Dark Blue; #47 Violet; #56 Lt. Green; #58 Green; #80A Blue; #82A Lt. Blue each **$14.95** (2.73)

Set #1–4 filters: #12, #23A, #58, #80A	**49.95** (4.54)
Set #2–4 filters: #11, #25A, #47, #82A	**49.95** (4.54)
Set #3–4 filters: #8, #21, #38A, #56	**49.95** (4.54)

Series 4000 Moon Filter (#ND96): Reduces glare and irradiation during lunar observing. 13% uniform light transmission across the visual spectrum. Threads into 1.25" barrels. **$16.95** (2.73)

#905 Variable Polarizer (1.25")

For glare reduction in observing the Moon. Includes two Polarizer filters mounted in a machined cell and permits continuously variable light transmission from 5% to 25%, to compensate for varying lunar surface brightness according to the Moon's phase and the aperture of the telescope. Accepts 1.25" eyepieces. **$49.95** (5.26)

Electric Focusers for SCT's

For extremely smooth microfocusing of the image. Does not affect use of the manual coarse-focus knob.

#1206 Electric Focuser: Plugs into control panel of Meade 8", 10", 12" LX200 models and operates from LX200 hand controller. **$149.95** (7.48)

#1205 Electric Focuser: For **all** other Meade 8", 10", 12" SCT models; includes separate hand controller; accepts one self-contained (user-supplied) 9v. battery.

$169.95 (7.88)

#777 Off-Axis Guider for SCT's

Internal prism diverts light for monitoring telescopic image during long-exposure astrophotography. Threads to any Meade or Celestron rear cell. Use with illuminated reticle eyepiece and T-Mount for your 35mm camera.

$79.95 (6.85)

2x Apochromatic Barlow Lens

Series 4000™

#140: The most advanced Barlow lens available for commercial telescopes, the Meade #140 includes 3-element, multi-coated, air-spaced optics. Doubles the power of any eyepiece with which it is used and yields images absolutely unmatched in resolution, contrast and color correction. The #140 optically complements any telescope — refractor, reflector, or Schmidt-Cassegrain. Accepts 1.25" eyepieces. Mechanical components are of machined aluminum and brass. Lens diameter is 28mm; clear aperture 26mm.

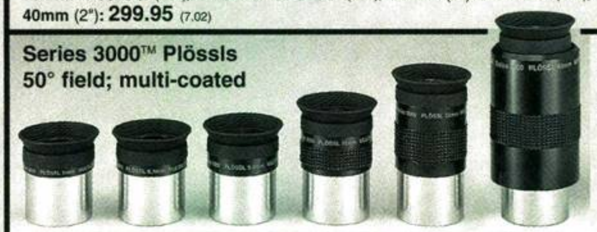
$79.95 (5.26)

Series 4000™ Super Wide Angle 67° field; multi-coated

For exquisite wide-angle images at low-to-medium powers, with pinpoint edge-of-field resolution. Ideal for star fields, galaxies, and other deep-space phenomena. SWA 13.8mm, 18mm, and 24.5mm are superb complements to the #140 Barlow, above.

Super Wide Angle (SWA; 6-elements; 1.25"; 67°)–**13.8mm: $139.95** (4.54); **18mm: 149.95** (4.54); **24.5mm: 179.95** (5.26); **32mm** (2"): **239.95** (7.02); **40mm** (2"): **299.95** (7.02)

Series 3000™ Plössls 50° field; multi-coated



Meade Series 3000 Plössls yield the finest image corrections obtainable from the classical 4-element Plössl design. Focal lengths from 5mm through 25mm are parfocal, so that, at most, only slight refocusing of the image is necessary from eyepiece to eyepiece. Unlike competing moderately-priced Plössls, Meade Series 3000's are **multi-coated** for maximum light transmission and image contrast. Chrome-plated brass barrels are threaded for standard filters. All eyepieces are fitted with fold-down rubber eyecups for comfortable observing. The PL40mm *(far right in photo)*, an excellent complement to any ocular set, produces spectacular low-power, wide fields, ideal for scanning the Milky Way. Manufactured exclusively to Meade optical designs, Series 3000 Plössls yield fine, high-resolution results on reflectors, refractors, and Schmidt-Cassegrains of any focal ratio.

Series 3000 Plössls (4-elements; 1.25"; 50°)

5, 6.7, 9.5, 16, 25mm each: **$49.95** (3.86); **40mm** (44° field): **$79.95** (3.86)

#911B
#910B
#908B
#911N
#910N
#908N

Series 4000 Nebular Filters—Premium multi-layer interference filters, the finest obtainable. Use broadband ("B") filters to block most forms of light pollution; use narrowband ("N") filters in heavily light-polluted areas or for extremely high-contrast observing of faint nebulae.

#908B–Threads into 1.25" eyepieces, 26mm dia.	**79.95** (4.54)
#910B–Threads into 2" eyepieces, 44mm dia.	**119.95** (5.26)
#911B–Threads on to rear cell of Schmidt-Cassegrain telescopes. 36mm dia.	**99.95** (5.26)
#908N–Threads into 1.25" eyepieces, 26mm dia.	**89.95** (4.54)
#910N–Threads into 2" eyepieces, 44mm dia.	**129.95** (5.26)
#911N–Threads on to rear cell of Schmidt-Cassegrain telescopes. 36mm dia.	**119.95** (5.26)

#911X
#910X
#908X

Series 4000 Oxygen-III Filters Observe diffuse emission and planetary nebulae as you never thought possible! Exclusive Meade *60-layer* interference coating technology isolates the 496nm and 501nm O-III lines to tremendously enhance observable nebular structural detail in all telescopes.

#908X–Threads into 1.25" eyepieces, 26mm dia.	**99.95** (4.54)
#910X–Threads into 2" eyepieces, 44mm dia.	**159.95** (5.26)
#911X–Threads on to rear cell of Schmidt-Cassegrain telescopes. 36mm dia.	**149.95** (5.26)

Modified Achromatic Eyepieces

Meade 3-element MA eyepieces yield sharp, well-corrected images on the Moon, planets, and deep-space at a reasonable price. Multi-coated; threaded for filters; 1.25" barrel diameter. Apparent field: 40°. **MA 9, 12, 25, 40mm.**

each: **$37.95** (4.54)

MA12mm Illuminated Reticle Eyepiece

Excellent 3-element optical system, long eye relief, fully coated, with double crossline reticle; rubber eyecup. Wireless red LED illuminator and variable brightness control. 1.25". **Batteries included.**

$99.95 (3.45)

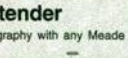
As above but with 6 ft. cord and plug for Meade telescopes with power panels, in place of wireless illuminator. **$79.95** (5.26)

Camera Adapters

Professional-quality adapters for rigid coupling of telescope-to-camera. Use for either Eyepiece-Projection or Prime Focus. Precision-machined of aluminum and brass, threaded for filters. Use with T-mount, available separately.

.965": $27.95; **1.25": $29.95** (3.86)

Variable Tele-Extender



For eyepiece-projection photography with any Meade or Celestron SCT. Threads on to eyepiece-holder. Sliding cell with lock permits wide range of projection magnifications with the same eyepiece. Use with T-mount for your camera.

$39.95 (3.86)

Variable-Projection Camera Adapter (1.25")

Machined sliding cell allows variable projection power in eyepiece-projection photography; permits precise selection of correct photo power in lunar and planetary photography; threaded for filters. Use with T-mount for your camera.

$39.95 (3.86)

T-Adapters for SCT's

Rigidly couples camera to telescope for prime focus photography with any Meade or Celestron Schmidt-Cassegrain. Use with T-Mount for your 35mm camera.

$26.95 (3.86)

CCD-Photo-Visual Flip-Mirror Systems

An essential accessory for imaging with ***any*** brand of CCD imager or for astrophotography with a 35mm camera. Flip mirror "down" to center the image while viewing with an eyepiece at 90°; flip mirror "up" to pass light on to CCD chip or 35mm camera film plane. Each unit includes: precision optical-flat Pyrex® mirror; 2-axis mirror-adjustment screws and locks for precise image centering; extra-fine helicoid focusing of the eyepiece; extension tubes for attaching either 35mm camera (using T-Mount) or CCD imager (using either T-threads or 1.25" barrel). Threads to rear cells of all Schmidt-Cassegrain telescopes; may remain on telescope and used in place of diagonal prism for visual observing as well.

"Over the past 10 years I have used all manner of flip-mirrors. The Meade Flip-Mirror Systems are absolutely the best—rock solid, high-precision, beautifully manufactured; they virtually eliminate all flexture between the CCD and telescope." — Jack Newton

#644 Flip-Mirror System: Accepts any 1.25" eyepiece. Mirror clear aperture: 22mm. Use with CCD's up to Pictor 416XT or ST-7, or smaller; or visual observing with 1.25" eyepieces. **$149.95** (7.02)

#647 Flip-Mirror System: Accepts either 1.25" or 2" eyepieces. Mirror clear aperture: 40mm. Recommended for full-field 35mm astrophotography or with CCD's of any size, including all Meade Pictor Series through 1616XT, as well as ST-4 through ST-8; or for visual applications with 1.25" or 2" eyepieces. **249.95** (8.49)

#157 1.25" Adapter: Permits use of either Flip-Mirror on telescopes with 1.25" eyepiece-holders. (Requires approx. 2" additional focus travel with #644, 3" with #647.) **15.00** (3.86)

#644

#647

Epoch 2000® Sky Software

The most powerful astronomical software ever made available can now be yours for only $149!

Epoch 2000sk *(upper display at left):* Now you can use the most advanced, most precise full-color sky software ever created, to zoom-in on telescopic fields **smaller than one arc second!** With star positions displayed as precisely as **0.01 arc second,** the Trapezium in Orion is no longer shown as a single point, as in other software, **but as four precisely oriented starpoints, just as they appear in the telescope.** No longer do you need to guess the R.A. and Dec. of an object located away from the field center, as in other programs: Epoch 2000sk dynamically reads out the R.A. and Dec. of the cursor position anywhere in the field **and updates R.A. and Dec. instantaneously as the cursor is moved about the field.** Meade LX200 owners can use Epoch 2000sk for remote auto-centering of objects in the telescopic field **to a precision of 30 arc seconds,** routinely!

Print professional-quality star charts in either black-and-white or color, at any zoom setting or sky scale between 180° and one arc second, with your own customized borders, headers, footers, margins, fonts, colors, and grids.

Epoch 2000ip Image Processing Software *(lower display at left)*: Epoch 2000ip makes it easy to enhance and analyze your CCD images with the same sophisticated techniques used by professional astronomers to uncover hidden structure in a spiral galaxy or obscure detail on the surface of a planet. This powerful software includes virtually every technique available for image enhancement. Techniques that bring out detail totally invisible in your original image, transforming it from the ordinary to the spectacular.

EPOCH 2000sk Sky Software: 281,000 objects supplied on 3.5" discs for Windows 3.1 or higher; fully compatible with Windows 95 . . . . **$149**

EPOCH 2000sk-CD Sky Software: 19 million objects, including the complete Hubble Guide Star Catalog; supplied on CD-ROM **179**

LX200 Interface Cable: for Meade LX200 operation by Epoch 2000sk **25**

EPOCH 2000ip Image Processing Software: Supplied on 3.5" discs for Windows 3.1 or higher; fully compatible with Windows 95 . . . . **$199**

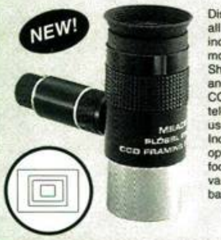
f/3.3 CCD FOCAL REDUCER

Series 4000™ f/3.3 CCD Focal Reducer/Field Flattener

NEW!

Revolutionary 3-element Meade design permits ultrafast CCD imaging with **increased** edge-of-field resolution and color correction! Reduces CCD exposure times by up to 80%. Threads on to the rear cell of any Meade or Celestron Schmidt-Cassegrain. Converts f/10 Schmidt-Cassegrain telescopes to **f/3.3** and f/6.3 SCT's to **f/2.** Variable T-Adapter (included) allows range of f/ratios between f/3 and f/5 on f/10 SCT's and between f/1.9 and f/3.2 on f/6.3 SCT's. Use with CCD imagers of any brand and chip dimensions. Not for visual or photographic applications. Multi-coated; 41mm clear aperture. **$149.95** (5.26)

Plössl 25mm Illuminated Reticle CCD Framing Ocular



Displays rectangular frames of all popular CCD chip sizes, including all Meade Pictor models and ST-4 through ST-8. Shows precisely the image size and orientation that appear on CCD chip. Insert directly into telescope eyepiece-holder, or use with Flip-Mirror *(above)*. Includes 4-element coated Plössl optics; lockable spacer ring to fix focus position; rubber eyecup; variable LED illumination control; batteries. 1.25".

$129.95 (4.54)

#825 8 x 25mm Right-Angle Viewfinder for ETX-90

Permits comfortable right-angle viewing. Replaces standard-equipment finder on 90mm ETX models, using the same bracket. Wide-angle, achromatic, coated optics; actual field 7.5°. Precise helicoid focusing.

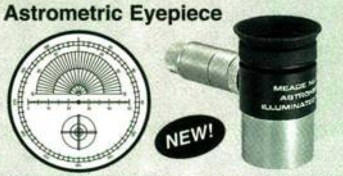
$49.95 (4.26)

#64 T-Adapter for ETX®

Threads to the photo port of all ETX-90 and ETX-125 models. Rigidly couples any 35mm camera with removable lens to the telescope for lunar, planetary, or terrestrial photography. Includes extension tube for longer effective focal length, if desired. Use with T-Mount for your 35mm camera.

$34.95 (3.86)

MA12mm Illuminated Reticle Astrometric Eyepiece



A high-precision eyepiece for a wide range of astronomical measurements. Includes four red-illuminated, laser-etched scales for measuring double star angular separations, position angles, planetary diameters, and lunar crater diameters, and for long-exposure photo-guiding. Modified Achromatic 3-element coated optics; diopter adjustment; rubber eyecup; variable LED illumination control; batteries. 1.25". **$119.95** (4.26)

Series 4000™ 8mm – 24mm Zoom Eyepiece

NEW!

The finest zoom eyepiece available. High-resolution 7-element multi-coated optics, with 55° field at 8mm. Graduated scale in 1mm units indicates exact focal length in use. High-eyepoint yields comfortable observing even with eyeglasses. Internal zoom lenses move on the smoothest, most precisely-machined tracks yet developed for zoom optics. Performance is fully consistent with the finest fixed-focal length eyepieces. Threaded for filters; rubber eyecup; 1.25". **$219.95** (6.38)

ETX® Hard Carrying Cases

For secure storage or travel with your ETX. Thick-wall construction and die-cut foam lining. Accepts telescope, plus optional eyepieces, erecting prism, table tripod, hand controller, *etc.* Includes two steel latches with key.

#774 Case for ETX-90 models: **99.95** (8.58)

#775 for ETX-125EC: **149.95** (13.38)

#932 45° Erecting Prism for ETX®

For terrestrial observing with any ETX-90 or ETX-125 model. Yields correctly oriented image and convenient 45° observing angle. Threads to ETX rear cell. Accepts any 1.25" eyepieces. Coated roof prism optics.

$49.95 (3.86)

Advanced Field Tripod for ETX-125

#887: Yields *rock-solid* stability for sensitive applications of the ETX-125, even at high magnifications. **Includes fixed-height tripod convenient for standing observations, equatorial wedge with alignment controls in azimuth and latitude angle, and #889 Tripod Adapter for ETX-125.** Permits either altazimuth or equatorial orientation of the telescope for astronomical or terrestrial observing. Tripod legs are 2"-diameter chromed steel. For field use the tripod collapses for easy transport.

$349.95 (14.00)

Tripod Adapter for ETX-125

Included with the #887 Tripod *(above)*, the #889 Adapter is available separately and permits attachment of ETX-125 directly to any Meade LX10, LX50, or LX200 Schmidt-Cassegrain Field Tripod for altazimuth observing or to any Meade Schmidt-Cassegrain Tripod-with-Equatorial Wedge or Superwedge for equatorial applications.

#889 Adapter:

$69.95 (7.70)

ETX® Deluxe Field Tripod

#883: Custom-designed by Meade specifically for ETX-90 and ETX-125 Astro Telescopes. Tripod height adjusts from 34" to 54", for seated or standing observations. Micrometric controls in azimuth and elevation permit precise polar alignment of the ETX fork mount. Tripod head tilts and locks to 90° for terrestrial applications. Telescope attaches to tripod in seconds with 2 thumbscrews. All-aluminum construction.

$199.95 (10.00)

ETX® Carry Bag

Soft-padded Cordura-type carry bag with shoulder strap; permits storage of any 90mm ETX model, plus table tripod legs, eyepieces, other accessories.

$36.95 (5.26)

NEW!

Electric Focusers for ETX®

ELECTRONIC CONTROLLER
MEADE

Meade-engineered for smooth, rapid focusing with any ETX model. Four-speed operation from coarse to microfine. Standard-equipment hand controller accepts one 9v. (user-supplied) battery and focuses all ETX telescopes. Or focus ETX/EC models through the telescope's hand controller.

#1244 Electric Focuser for all ETX-90 models: **$119.95** (6.85)

#1247 Electric Focuser for ETX-125 models: **$119.95** (6.85)

HOW TO ORDER

Prices shown are suggested U.S.A. mail-order retail prices and do not include any applicable sales taxes. Suggested shipping and handling charges to the 48 states by U.P.S. or U.S. Mail shown in ( ) next to each price. **The following national mail-order dealers carry all Meade accessories in-stock for immediate shipment:**

ASTRONOMICS, Norman, OK.
Orders: 800-422-7876; Info.: 405-364-0858.

FOCUS CAMERA, Brooklyn, NY.
Orders: 800-221-0828; Info.: 718-436-6262.

LUMICON, Livermore, CA.
Orders: 800-767-9576; Info.: 925-447-9570.

OCEANSIDE PHOTO & TELESCOPE, Oceanside, CA.
Orders & Information: 800-483-6287.

POCONO MOUNTAIN OPTICS, Moscow, PA.
Orders: 800-569-4323; Info.: 570-842-1500.

RIVERS CAMERA, Dover, NH.
Orders: 800-245-7963; Info.: 603-742-4888.

SHUTAN CAMERA & VIDEO, Chicago, IL.
Orders & Info.: 800-621-2248; IL: 312-332-2000.

Canada:

EFSTONSCIENCE, Toronto, Ontario.
Orders & Information: 416-787-4581.

KHAN SCOPE CENTRE, Toronto, Ontario.
Orders & Information: 416-783-4140.

© 2000

THE LARGEST-SELLING TELESCOPES IN THE WORLD

MEADE

See these authorized Meade dealers for information on any of forty Meade telescope models, from entry-level telescopes under -$200 to professional instruments over $15,000.

NATIONAL

Meade Telescopes and Accessories are available at

DISCOVERY CHANNEL STORE

Call for location nearest you.
Call **1-800-222-6105**

CALIFORNIA

Claremont Camera & Video

If it's quality Meade telescopes you're looking for – We offer it all!

863 W. Foothill Blvd., Claremont, CA 91711
909-626-2219

FLORIDA

National Camera & Digital Imaging

Competitive Prices! Expert Service! Sales Nationwide! 35 Year Reputation.

1650 North Military Trail, Suite 104
West Palm Beach, FL 33409, **561-689-3155**
Out of State **1-800-9-CAMERA**

ARIZONA

ASTRONOMY SHOPPE

Authorized Meade Dealer
Serving the Greater Phoenix Area

3202 E. Greenway Rd., Suite 1615,
Phoenix, AZ 85032
1-888-999-6396

CALIFORNIA

Huge Meade inventory at low prices

Woodland Hills Camera

Telescopes • Binoculars

5348 Topanga Canyon Blvd., Woodland Hills, CA 91364
818-347-2270 or toll-free
Buy, Sell **1-888-4-ASTRONOMY** ***Trade***

FLORIDA

Complete line of fine Meade Products

Kenin Scientific & Optical Products

Big Display and We Do Mail Orders

1830 N.E. 163 St. • North Miami Beach
Phone: **305-940-7804** • Fax: **305-947-5943**

ARIZONA

Quality Meade telescopes and accessories

Mr. Telescope

20 E. Camelback Rd., Phoenix, AZ 85012
602-955-5521

CALIFORNIA

Largest Meade Display in California!

Boot's Camera

5587 North Blackstone Ave.,
Fresno, CA 93710
559-432-0446

IOWA

THINKER TOYS, INC.

Quality Meade telescopes and accessories

4400 Singing Hills Boulevard
Sioux City, IA 51106
712-271-8697

ARIZONA

Quality Telescope and Accessories

Sky Works®

The Astronomy Drugstore...Get Your R_x Here!

7401 E. 22nd Street, Tucson, AZ 85701
520-751-6752 • fax: 520-751-6758
www.sky-works.com

COLORADO

Mike's Camera, Inc.

We carry one of the largest supplies of quality telescopes and accessories.

Boulder	Littleton	Denver
303-443-1715	**303-708-9655**	**303-733-2121**

GEORGIA

Camera Bug Ltd.

Atlanta's Leading Telescope and Binocular Dealer.
We Ship Practically Anywhere.

1799 Briarcliff Rd., Atlanta, GA 30306
404-873-4513 • Fax 873-3925

CALIFORNIA

Studio City Camera

Full-line Meade. Optical expert on staff. Over 50 years' experience selling telescopes!

12174 Ventura Blvd., Studio City, CA 91604
818-762-4749

CONNECTICUT

WHOLESALE OPTICS

WWW.ASTROPTX.COM
E-MAIL: astroptx@astroptx.com
Phone Orders 7 Days 9 am - 12 midnight • Sat. Hrs.: 11 am - 5 pm

Showrooms/Business Office:
57 North St., Suite 401, Danbury, CT 06810
Phone: **860-355-3132**

MASSACHUSETTS

F.C. Meichsner Co.

Decades of sales and service to New England's astronomers. Visit our accessible Boston showroom.

182 Lincoln St., Boston, MA 02111
1-800-321-VIEW

CALIFORNIA

WHAT IN THE WORLD

We will demo Meade products in our dark mountain skies!

28200 Hwy. 189, #E-210
Lake Arrowhead Village, CA 92352
909-337-5080

DELAWARE

CUTLER CAMERA

Binocular and Telescope Specialists

Stores in Wilmington, Newark and Dover
403 Branmar Plaza, Wilmington, DE 19810
888-442-8821

MASSACHUSETTS

Full-line dealer! We accept trade-ins! Meade telescopes on display for your inspection!

Harvard Camera

Town of Harvard: **978-456-8100**
e-mail: harvardcamera.com

MICHIGAN

RIDER'S HOBBY SHOPS
Serving Michigan Since 1972
Competitive Discount Prices
For the store location nearest you call **888-530-9780**. Locations throughout Michigan. HTTP://RIDERS.COM

MINNESOTA

RADIO CITY INC.
Full stocking Meade dealer serving the upper midwest. "We can help." radioinc.com
2663 County Rd. I, Mounds View, MN 55112
1-800-426-2891 • 763-786-4475

MONTANA

NIGHT SKIES
Come and see the largest display of telescopes and accessories in Montana.
1550 Amsterdam Rd., Belgrade, MT 59714
Phone: **406-388-1205** e-mail: **nightsky**@wtp.net

NEBRASKA

ROCKBROOK CAMERA & VIDEO
Nebraska's Authorized Meade Dealer
2 Locations:

108th & W. Center Rd.	40th & O St.
Omaha, NE 68144	Lincoln, NE 68510
402-397-1171	**402-488-4200**

NEW JERSEY

N.J.'s Largest Display of Meade Telescopes.
Dover Photo Supply
25 E. Blackwell St.
Dover, NJ 07801
973-366-0994

NEW JERSEY

EDMUND SCIENTIFIC COMPANY
Call for a free catalog or see our full Meade line in our showroom.
101 East Gloucester Pike, Barrington, NJ 08007
1-800-728-6999

NEW MEXICO

PhotoSupply, Inc.
Stocking New Mexico's largest selection of Meade telescopes.
DeVargas Shopping Ctr., Santa Fe, NM 87501
505-982-2585

NEW YORK

Berger Bros. Camera & Video Exchange
Excellent Advice, Prices and Reputation For 50 Years
209 Broadway (Rte. 110), Amityville, LI, NY 11701
1-800-262-4160 • 631-264-4160

NEW YORK

B & H PHOTO VIDEO
We carry a full line of quality Meade telescopes
420 9th Avenue, New York, NY 10001
www.bhphotovideo.com
1-800-947-9970 • (212) 444-6670

NEW YORK

We have specialized in sales and repair of telescopes for over 20 years! See us for expert advice!
Johnson Camera
6565 Kinne Rd. at Erie, Syracuse, NY 13214
315-446-0290

NORTH CAROLINA

Your quality Meade dealer in North Carolina
CC Sales/ Camera Corner
Phone: **800-868-2462**
Fax: **336-222-8011**
e-mail: **sky@camcor.com**
2273 S. Church St., Burlington, NC 27215

OHIO

Pete's PhotoWorld
Competitive Prices! ***Great Service!***
Telescope expert on staff ***Ask for Craig***
Telescope FAQ's www.photoworld.com
7731 Beechmont Ave, Cincinnati, OH 45255
petes@photoworld.com 1-800-736-7383

OHIO

McALISTER CAMERA & VIDEO
Full Line Meade. Reputable Dealer With Competitive Prices. Call Eric For Advice.
588 W. Schrock Road
Westerville, OH 43081 (Columbus)
Phone: 614-794-1865

PENNSYLVANIA

The Camera Shop In Bryn Mawr
Suburban Philadelphia's
Photo & Optical Specialists
572 Lancaster Ave., Bryn Mawr, PA 19010
610-527-0300

PENNSYLVANIA

CUTLER CAMERA
Binocular and Telescope Experts
7 Locations in PA and NJ
Largest Dealer in the Delaware Valley
314 Horsham Rd., Horsham, PA 19044
215-674-5727 • 1-800-220-5727

SOUTH CAROLINA

Wonder Works
Friendly, helpful service!
Open 7 days a week.
280 W. Coleman Blvd., Mt. Pleasant, SC 29464
Toll-Free 888-849-5540
www.wonderworkscharleston.com

TEXAS

Analytical Scientific
If it's a quality Meade telescope you're looking for, call us.
11049 Bandera Rd., San Antonio, TX 78250
210-684-7373 • 800-701-STAR
http://www.analyticalsci.com

TEXAS

Land, Sea & Sky Unlimited
Complete sales and service of Meade telescopes. We are optical specialists.
3110 S. Shepherd Dr., Houston, TX 77098
713-529-3551
www.neosoft.com/~lsstnr

WASHINGTON

Captain's Binoculars & Telescopes
Optical specialists, not just order-takers. • 2 locations:
2500 15th Ave. West, Seattle, WA 98119
206-283-7242
3333 184th St., S.W., Suite W, Lynnwood, WA 98037
425-670-8797
www.captainsnautical.com

WASHINGTON

Meade Telescopes & Accessories
The Naturium
Kitsap Mall, Silverdale, WA
360-698-3580

WASHINGTON

Anacortes Telescope & Wild Bird, Inc.
3202 Commercial Ave., Anacortes, WA 98221
360-588-9000 • Fax 360-588-9100
http://www.buytelescopes.com

WISCONSIN

EAGLE OPTICS
Authorized Meade Dealer. We've built a nationwide reputation for quality sales and service.
2120 W. Greenview Dr., Middleton, WI 53562
1-800-289-1132
www.eagleoptics.com

CANADA

PERCEPTOR
Friendly Service, Expert Advice, Low Prices, Full Meade Line, Delivery Across Canada
Brownsville Jct. Plaza, Box 38, Suite 201
Schomberg, Ontario L0G 1T0
905-939-2313 • Fax 905-939-8274

CANADA

LA MAISON DE L'ASTRONOMIE
Competitive Prices • Expert Service
8074 St. Hubert, Montreal, Quebec H2R 2P3
514-279-0063 • Fax **514-279-9628**
e-mail: rlotte@interlink.net
http://www.microid.com/maison.htm

It's An Ageless Career

Your "Astronomy Careers Beckon" article (November 2000) provided an informative and realistic view of the post-graduate job market. As a current undergraduate in astrophysics and physics at the University of Minnesota's Institute of Technology, I am amazed (and sometimes overwhelmed) by the amount of physics and mathematics required.

I also found the sidebar on Janice Lee, the 26-year-old grad student who decided to change careers, slightly humorous. At age 30, I decided to leave nursing and start a new career.

Four years later, I'm still at it and enjoying (almost) every minute of it. The comment on being an older student and changing careers struck me as rather funny because here I am, taking junior-level classes at age 37. — *Bob Alden, Minneapolis, Minnesota*

Junked Up

"Space Junk" (December 2000) was simultaneously interesting and frightening. The article quite clearly showed the Earth-shattering consequences that could occur as a direct result of our foolishness and carelessness.

I'm hopeful that we can find a realistic, cost-effective method to clean up the mess we've made. Otherwise, we should brace ourselves for a modern-day Big Bang. — *Joseph Daudish, Westchester, Illinois*

Right now at least 5,510 tons of debris, including garbage dumped by various missions and space stations, are orbiting Earth.

How ironic that we sent men to the moon and can ponder colonizing Mars but cannot find a way to eliminate the stains of human presence in our once-pristine exosphere. — *Peter L. Venezia, Hauppauge, New York*

Are Ewe Sure?

Bob Berman pulled the wool over readers in his December 2000 column, when he stated that Betelgeuse means "Sheep's Armpit."

Over the centuries, various civilizations developed different myths and legends around Orion — one of the easiest constellations to recognize.

Sorry, Bob, you need a better reference. According to my *Webster's College Edition New World Dictionary*, Betelgeuse originated from the Arabic "bayt al jauza," which literally means "house of the twins." — *Douglas K. Howard, Brookings, Oregon*

Sources vary for this definition. In his Celestial Handbook *(Dover Publications, New York, 1978, page 1281), astronomer Robert Burnham says that the star is usually translated "the armpit of the giant." Many dictionaries have changed "armpit" to "shoulder."*

Arguably the very best source of star name meanings — certainly those of Arabic origin — is the late, well-known lawyer, Arabic scholar and amateur astronomer George A. Davis. ("Pronunciations, Derivation, and Meanings of a Selected List of Star Names," Popular Astronomy, *1944, recently reprinted).*

Davis's preface lays to rest many misconceptions. He states that the name Betelgeuse comes from the Arabic "ibt al-jauza," literally meaning "the armpit of the white belted sheep." This stems from the undisputed fact that the earliest Arabs saw a sheep in the stars that we recognize as a hunter — Orion.

Life is funny, isn't it? I'd never have guessed that I'd someday defend a sheep's armpit. — Bob Berman

Change Cultural Vision

In his December 2000 letter titled "Counterpoint," Briton Jason Richardson describes planetary colonization as the only way to save humanity and identifies overpopulation on Earth as the world's most severe problem.

Exporting our cultural vision of converting our planet's biomass into human biomass to another planet is unlikely to save humanity or solve Earth's problems.

Totalitarian agriculture (as some call it) will always create overcrowding, as it has here in a blink of geological time (about 10,000 years or 500 human generations). Also, this behavior has brought us to the verge of global collapse.

The good news is that we shouldn't have to change humanity (an impossible undertaking) to solve these problems. Instead, our cultural vision needs changing. — *Uwe Schuerkamp, Herford, Germany*

Astronomy

KALMBACH PUBLISHING CO.

PRESIDENT
Gerald B. Boettcher

VICE PRESIDENT, EDITORIAL, PUBLISHER
James J. Slocum

VICE PRESIDENT, MARKETING
Michael R. Stephens

VICE PRESIDENT, ADVERTISING
Scott Stollberg

CORPORATE ART DIRECTOR
Maureen M. Schimmel

MANAGING ART DIRECTOR
Lisa A. Zehner

PRODUCTION MANAGER
Annette Wall

CIRCULATION DIRECTOR
Jerry Burstein

CIRCULATION SPECIALIST
Kirsten King

ADVERTISING DEPARTMENT
(888) 558-1544

ADVERTISING SERVICES MANAGER
Sara Malin Everts severts@kalmbach.com

ADVERTISING SALES MANAGER
Howard Hoerl hhoerl@astronomy.com

ADVERTISING SALES REPRESENTATIVE
Michael Ellis mellis@astronomy.com

AD SERVICES REPRESENTATIVE
Joel Wingelman jwingelman@kalmbach.com

RETAIL TRADE ORDERS AND INQUIRIES:
(800) 558-1544, ext. 818; outside the U.S. and Canada: (262) 796-8776, ext. 818

SPECIAL E-MAIL ADDRESSES

Ask Astro askastro@astronomy.com
Hot Shots hotshots@astronomy.com
Star Stuff starstuff@astronomy.com
Talking Back talking@astronomy.com
Kids kids@astronomy.com
Customer Service customerservice@kalmbach.com
Ad Sales adsales@astronomy.com

A new doorway is opening to the Universe!

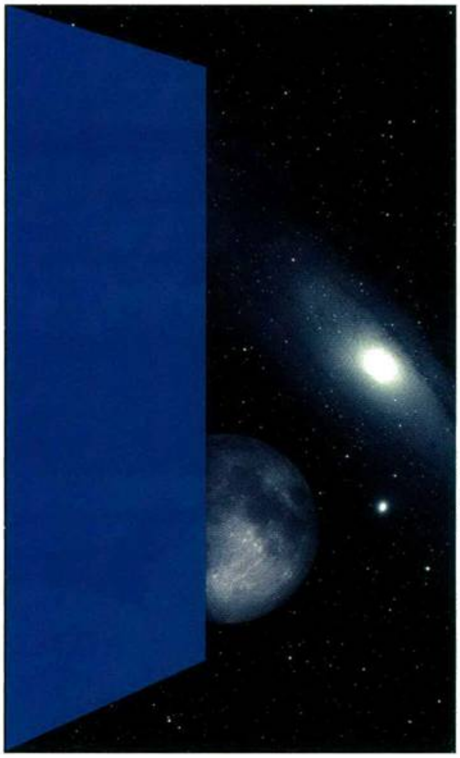


Photo: REU program, N.A.Sharp/AURA/NOAO/NSF

Astro-tourism defined for the new age of exploration

DURANGO MOUNTAIN RESORT COLORADO

STAR SAFARIS

KIRKWOOD
Kirkwood Mountain Resort
www.skikirkwood.com

Astronomy Magazine

www.StarSafaris.com

Let's Talk Stars
ASTRONOMY TALK RADIO
WITH YOUR HOST David H. Levy
LISTEN ON THE INTERNET
WWW.LETSTALKSTARS.COM

OPT
Since 1947
LET'S UNLOCK THE MYSTERY OF THE UNIVERSE!

What our customers say...
"Thank you for excellent advice and help"
M. Escondido, CA
"Your employees have a genuine interest in the hobby"
M.S. Eagle, CO

We have the most knowledgeable, friendly, bend-over-backwards, knock-themselves-out-for-you staff anywhere in the universe
www.optcorp.com
On Line Catalog

ETX-125EC
ETX-90EC
plus accessories
Meade THE LEADER'S EDGE

SBIG ASTRONOMICAL INSTRUMENTS
The Leader in CCD Imaging

Meade THE LEADER'S EDGE
7", 8", 10"& 12" LX200's in stock
Computer Robotic Telescope

TeleVue Visionary
Televue specialists here to help you!

We're not just a phone number— we're a real store!

JMI • KENDRICK
LOSMANDY
LUMICON
OPTEC • ORION
1000 OAKS
SBIG • DISCOVERY

NexStar 5
Computer Robotic Telescope In Stock!
CELESTRON

OCEANSIDE PHOTO & TELESCOPE
1024 MISSION AVE
OCEANSIDE CA 92054
OPEN 7 DAYS
email: opt@optcorp.com
1-800-338-9638

Space Jewel

Bob Berman's "Strange Universe" is a jewel and a lot of fun. Don't let it get away. — *J. E. Stockton, Weslaco, Texas*

Ending It All

"Embracing the End" (October 2000) left me wondering why the authors didn't take the story a step further. In the last paragraph, the only things left in the universe were black holes of various sizes. What about their fate? Will they evaporate as Stephen Hawking proposes? Or will they merge into a singularity with the same qualities as the one that began the universe?

That would cause a huge problem for cosmologists who currently reject an oscillating model and believe the universe will expand forever. — *Roger Sargent, Albion, Pennsylvania*

You are right — the story does not end at the close of the Degenerate Era. Black holes continue to shine by emitting Hawking radiation and act as the stellar beacons for the next age of the universe, called The Black Hole Era. But even black holes cannot live forever. As they radiate, black holes squander their tightly held mass energy and ultimately evaporate. After that, the universe changes again and enters the Dark Era.

The rest of the story is contained in The Five Ages of the Universe: Inside the Physics of Eternity, *by Fred C. Adams and Greg Laughlin (Free Press, New York, 1999).* — Fred C. Adams, University of Michigan

Mission Postponed

"NASA Shelves Pluto Mission" (January 2001) listed an incorrect planned-arrival date for the now-postponed Pluto-Kuiper Express (PKE) mission. A launch date in 2004 would have enabled the spacecraft to rendezvous with Pluto in 2012. — *Astronomy* editors

---

Astronomy *invites you to talk back. Send letters to* Astronomy *Talking Back, P.O. Box 1612, Waukesha, WI 53187; e-mail to talking@astronomy.com. Letters may be edited for space and clarity. Please include your city, state, and country with all correspondence. If you want to talk back to us, please visit our website, http://www.astronomy.com.*

For more than 200 years, American authors have been creating works that are every American's literary estate

William Faulkner

Ernest Hemingway

F. Scott Fitzgerald

Prints and Photographs Division, Library of Congress

Claim your ownership of this priceless inheritance—in a monumental 84-lecture series on the **Classics of American Literature**...in your choice of audio- or videotape!

Order & save up to $350 on this special offer from The Teaching Company!
Sale prices good through March 15, 2001

What gets *you* most excited about writers and writing? If you're like most people who love to read, it's the great works themselves.

No matter how fascinating the personal lives the great writers draw on for their art, or the critical debates that orbit around them, it is the joy we derive from reading and hearing the *actual masterpieces*—the classic novels, short stories, plays, poems, and essays that our greatest writers give us—that earns them their place in our hearts.

That's why it's such a pleasure to announce that our newest and most ambitious literature course—the seven-part Classics of American Literature—is now being offered at a special price, in your choice of audio- or videotape.

We are making this special offer in order to introduce you to The Teaching Company, the renowned educational enterprise that puts America's most outstanding college teachers on tape, so that you or anyone who shares your joy of learning and intellectual growth can enjoy them wherever and whenever you choose.

Classics of American Literature is a course you'll come back to again and again. Not only for the sheer joy of experiencing the most brilliant pieces of American literature ever created, but for understanding them, as well.

This is a course that has been crafted to explain just why it is that some works become classics while others do not. Why some "immortal" works eventually fade from our attention completely. And even why some contemporary works now being ignored, or even laughed at by critics, may nevertheless be considered immortal a century from now.

One memorable work at a time, you'll see how each of these classic masterpieces shares the uncompromising *strangeness*—what critic Harold Bloom has called the "uncanny startlement"—that invariably marks the masterpieces of the American literary canon, from Hawthorne to Melville, Dickinson to Whitman, Faulkner to Morrison, and so many others.

The course was born out of Professor Weinstein's conviction that American literature is our "great estate," and that *claiming* this rightful inheritance—these great writers' *shared awareness of a living past and the lessons we can take from it*—should be nothing less than a unique and joyous learning experience.

Like all Teaching Company professors, Dr. Weinstein has been chosen from "the best of the best"—top-flight scholars from colleges and universities across America who have distinguished themselves with teaching that wins awards and consistently earns them high marks in the brutally honest student evaluations that are compiled about teachers on many campuses.

Superbly prepared and clearly in love with his subject, Professor Weinstein leads you through more than two centuries of the best writers America has ever produced, bringing out in every lecture the beauty of their language, the excitement of their stories, and the sheer importance of what they had to say about life, power, love, adventure, and what it means, in every sense, to be *American*.

This is a particularly vivid course, rich in the feeling of the writers and their times. Many customers prefer the convenience of the audio format for long commutes or during exercise. Should you desire video, you will see some period photography, illustrations, and on-screen text to help bring the writers and their works to life.

No matter which version of the course you order you'll be getting the unique educational experience that has made The Teaching Company the choice of thousands of educated people like you, for whom the joys of the mind—of serious thought—are an unequalled pleasure.

Please let us hear from you today.

Part I covers Benjamin Franklin's Autobiography, the works of Washington Irving, Ralph Waldo Emerson, Henry David Thoreau's Walden, and stories by Edgar Allan Poe

Part II covers Nathaniel Hawthorne's The Scarlet Letter, Herman Melville's Moby Dick and "Benito Cereno," and the work of Walt Whitman

Part III continues with Whitman, then moves to Harriet Beecher Stowe's Uncle Tom's Cabin, and the poetry of Emily Dickinson

Part IV covers Mark Twain's The Adventures of Tom Sawyer, Huckleberry Finn, and Pudd'nhead Wilson, Henry James' The Ambassadors and The Turn of the Screw, Stephen Crane's The Red Badge of Courage, and the work of Charlotte Perkins Gilman

Part V continues with Gilman, then covers the work of Robert Frost, T.S. Eliot's The Waste Land, F. Scott Fitzgerald's The Great Gatsby, and Ernest Hemingway's The Sun Also Rises

Part VI covers Hemingway's The Garden of Eden, William Faulkner's The Sound and the Fury and Absalom, Absalom!, John Steinbeck's The Grapes of Wrath, and Ralph Ellison's Invisible Man

Part VII continues with Ellison, then covers plays by Eugene O'Neill, Tennessee Williams, and Arthur Miller, and concludes with Toni Morrison's Beloved

> *"He [Professor Arnold Weinstein] is one of the best you have. I have listened to all of his courses. He has a superb way of teaching."*
>
> —DENNIS BREZINA, CHESAPEAKE CITY, MD
>
> *"You [The Teaching Company] perform an invaluable service in bringing the world of knowledge to those in search of truth and broadening their intellectual horizons."*
>
> —CYRIL FITCH, PITTSBURGH, PA

NO-RISK MONEY-BACK GUARANTEE!

About Your Professor:

Arnold Weinstein (Brown University)An extraordinary scholar and educator, Professor Weinstein, Brown's Edna and Richard Salomon Distinguished Professor, was recently honored as Brown's Best Teacher in the Humanities. He has studied and taught at major universities all over the world and is the author of *Fictions of the Self: 1550-1800* (1981), *Vision and Response in Modern Fiction* (1984), *The Fiction of Relationship* (1988), and *Nobody's Home: Speech, Self and Place in American Fiction from Hawthorne to DeLillo* (1992). He is currently working on a study of the relationship between artistic expression and the urban experience.

Shop securely on-line at:

www.teachco.com

SAVE UP TO $350! OFFER GOOD UNTIL MARCH 15, 2001

To order, mail coupon below or call our toll-free number: (Please refer to Priority Code 10872)
1-800-TEACH-12 (1-800-832-2412), Fax: 1-703-912-7756
or Shop securely on-line at: www.teachco.com

The Teaching Company®
7405 Alban Station Court, Suite A107
Springfield, VA 22150-2318
www.teachco.com
Priority Code 10872

Please send me the complete seven-part **Classics of American Literature**, consisting of 84 half-hour lectures, with complete lecture outlines, suggested reading list, and protective storage case at the special sale price of:

FREE SHIPPING!

☐ **Audio SALE—$199.95** (regular price $399.95) ~~(+$20 shipping, handling & insurance)~~

☐ **Video SALE—$249.95** (regular price $599.95) ~~(+$20 shipping, handling & insurance)~~

**Note: Virginia residents please add 4.5% sales tax.*

☐ Check or Money Order enclosed

☐ VISA ☐ MasterCard ☐ DISCOVER NOVUS ☐

ACCOUNT NUMBER

SIGNATURE EXP. DATE

NAME (PLEASE PRINT)

MAILING ADDRESS

CITY/STATE/ZIP

PHONE *(If we have questions regarding your order)*

☐ **FREE CATALOG. Please send me a free copy of your current catalog** (no purchase necessary).
Offer Good Through: March 15, 2001

exploration destination

Just because you favor dark skies doesn't mean you should be in the dark when it comes to shopping for Astronomy gear. At eHobbies you will find everything you need for your next star party, including telescopes and accessories, binoculars, star charts, books and software. Whether you're a backyard astronomer or an expert looking for the next great celestial discovery, our unparalleled customer service will save you enough time to tackle the Messier marathon.

8" NexStar Telescope
by CELESTRON
There is no substitute for size. With Celestron's legendary 8-inch optics, now you can see deeper into space with the same ease as with the innovative NexStar 5. With the touch of a button, the NexStar 8 will open doors to planets, galaxies and nebulae that you might not have ever experienced in your lifetime.
~~orig. price $1,899.99~~
NEW eHobbies price: $1,699.99
Your Savings $200.00
Item #1003-9772

4" NexStar Telescope
by CELESTRON
Featuring high-quality Maksutov-Cassegrain optics, the NexStar 4 is an ideal telescope for observing and photographing the wonders of space. Incredible light-gathering and a full degree field of view give you views 189% brighter than a 60mm refractor. Plus the Flip Mirror Control and Straight Through Photographic Port help make short-exposure astrophotography a heavenly experience.
eHobbies price: $699.99
Item #1006-0463

▲ 5" NexStar Schmidt-Cassegrain Telescope
by CELESTRON
eHobbies price: $1,199.99
Item #1004-1135

▲ NexStar 80 HC Refractor
by CELESTRON
eHobbies price: $299.99
Item #1006-0035

▼ G - 8 Schmidt-Cassegrain
by CELESTRON
eHobbies price: $999.99
Item #1004-2441

▼ Firstscope 114 Reflector
by CELESTRON
eHobbies price: $299.99
Item #1006-0201

▲ G - 9 1/4" Schmidt-Cassegrain
by CELESTRON
eHobbies price: $1,349.99
Item #1004-1262

▲ CM - 1100: 11" Schmidt-Cassegrain
by CELESTRON
eHobbies price: $3,199.99
Item #1004-2468

▲ G-5 with Motor Drive Telescope
by CELESTRON
eHobbies price: $749.99
Item #1004-1134

▲ NexStar 60 GT Refractor
by CELESTRON
eHobbies price: $299.99
Item #1006-0034

▼ C102-HD Refractor Telescope
by CELESTRON
eHobbies price: $499.99
Item # 1003-9769

▼ 100x4.5" Voyager Compact Telescope
by BUSHNELL
eHobbies price: $189.99
Item #1004-1786

we carry products from these great manufacturers…

Celestron, Fujinon, Bushnell, Zeiss, Kalmbach, Meade, Pelican Products, Space.com, Sky Publishing and more.

hot deals

Find amazing deals on optics, media and accessories in our **hot deals** area.

1-888-eHobbies

order by phone or online – 24 hours a day, 7 days a week

©2000 eHobbies.com, Inc. All rights reserved. The eHobbies logo and "creating a new world for hobbyists" are servicemarks of eHobbies.com, Inc.

Log on to our web site for a complete selection of telescope accessories.

▲ **Firstscope 60EQ Aluminum**
by CELESTRON
eHobbies price: $159.99
Item #1006-0089

▲ **TableTop 76**
Newtonian Telescope
by CELESTRON
eHobbies price: $99.99
Item #1004-1114

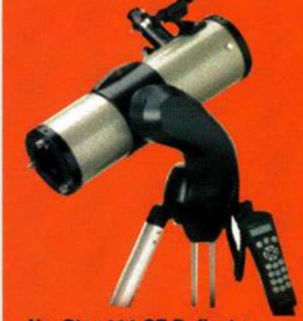
▲ **Firstscope 60AZ**
Deluxe Aluminum
by CELESTRON
eHobbies price: $159.99
Item # 1006-0088

▼ **Lanthanum 12mm Ocular 1.25"**
by CELESTRON
eHobbies price: $115.99
Item #1004-1255

▼ **Axiom 19mm Ocular 1.25"**
by CELESTRON
eHobbies price: $159.99
Item #1004-2602

▼ **Barlow Lens Ultima 2 X 1.25"**
by CELESTRON
eHobbies price: $69.99
Item #1004-1472

BEST BETS FROM CELESTRON



NexStar 114 GT Reflector
by CELESTRON
The NexStar 114 Newtonian reflector has 265 times the light gathering power of the average human eye, revealing fine detail within galaxies and nebulae.
eHobbies price: $499.99
Item #1006-0038

Firstscope 80EQ Refractor
by CELESTRON
This high-quality altazimuth refractor is an excellent choice for the serious beginning astronomer or terrestrial observer. Comes with a rugged wooden tripod.
eHobbies price: $349.99
Item #1006-0200

Star Hopper 4 1/2 Telescope
by CELESTRON
Celestron's Dobsonian design, the Star Hopper, is great for beginners because it's very easy to use and quite economical.
~~**orig. price $239.99**~~
NEW eHobbies price: $179.99
Your Savings $60.00
Item #1004-1128

7x50 Ultima Series Binocular
by CELESTRON
Celestron's Ultima Series binoculars are sleek in appearance with superb image quality that rivals the very best European models.
eHobbies price: $239.99
Item #1004-1217

EYEPIECES

Item #	Description	Manufacturer	Price
1004-1247	Lanthanum 2.5mm Ocular 1.25"	Celestron	115.99
1004-1249	Lanthanum 4mm 1.25"	Celestron	115.99
1004-1255	Lanthanum 12mm Ocular 1.25"	Celestron	115.99
1004-1250	Lanthanum 5mm Ocular 1.25"	Celestron	105.99
1004-1252	Lanthanum 6mm 1.25"	Celestron	105.99
1004-1253	Lanthanum 9mm Ocular 1.25"	Celestron	105.99
1004-1244	Ultima (5 Element) 35mm 1.25"	Celestron	115.99
1004-1245	Ultima (5 Element) 42mm 1.25"	Celestron	98.99
1004-1242	Ultima (5 Element) 18mm 1.25"	Celestron	79.99
1004-2602	Axiom 19mm Ocular 1.25"	Celestron	159.99
1004-1472	Barlow Lens Ultima 2 X 1.25"	Celestron	69.99

BOOKS & SOFTWARE

Item #	Description	Manufacturer	Price
1004-0651	Starry Night Pro Astronomy Software	Space.com	129.99
1004-2326	Photographic Atlas of the Stars	Kalmbach	39.99
1004-3443	The Backyard Astronomer's Guide	Sky Publishing	39.99
1004-3439	Astrophotography/Amateur, 2nd Ed	Sky Publishing	34.99

***All prices are subject to change.**

TELESCOPE ACCESSORIES

Item #	Description	Manufacturer	Price
1004-2246	Adapter AC for Celestar 8	Celestron	15.99
1004-1287	Camera T-Ring Canon, Celestron	Celestron	14.99
1004-2628	Collimation Eyepiece - 1-1/4"	Celestron	32.99
1004-2250	Collimation Tool for Newtonians	Celestron	6.99
1004-2861	Dew Shield C11	Celestron	51.99
1004-2255	Dew Shield C8	Celestron	32.99
1004-2254	Dew Shield G5	Celestron	25.99
1004-2259	Diagonal, Erect Image, 45 Deg, 1.25"	Celestron	34.99
1004-2773	Finder Bracket - Quick Release	Celestron	42.99
1004-2253	Flashlight, Night Vision	Celestron	19.99
1004-2856	LensPen - Optics Cleaning Tool	Celestron	9.99
1004-2881	Moon Filter - 1-1/4"	Celestron	10.99
1004-2907	Solar Filter for F60s, F60EQs	Celestron	19.99
1004-1275	T-Adapter (C5/C8/G8/G9.25"/C11/C14)	Celestron	24.99

We are an authorized dealer of Meade products.

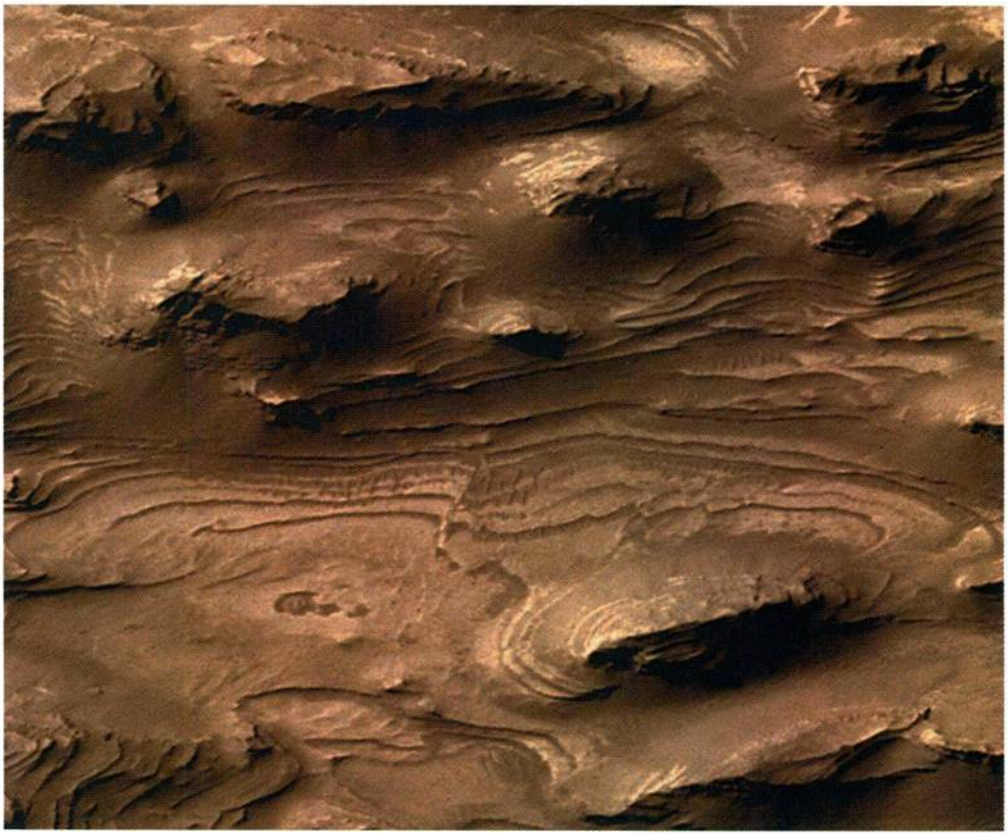
AST_0010

www.eHobbies.com
AOL Keyword: eHobbies

eHobbies℠
creating a new world for hobbyists℠

MARS GLOBAL SURVEYOR

Mars Geology Grows More Intriguing



All images: NASA/JPL/MSSS

Mars abounds with rock layers that likely formed when sediments accumulated in ancient lakes. Stunning examples occur in Valles Marineris (above) and in Pollack crater (far left; closeup at left).

▶ Investigators on the imaging team of NASA's plucky Mars Global Surveyor spacecraft have added another stunning discovery to the growing list of revelations about the Red Planet. Mike Malin and Ken Edgett of Malin Space Science Systems in San Diego, who headed the latest effort, found what appear to be thick masses of stratified sedimentary rock.

If correct, this interpretation strongly suggests that many craters and parts of the huge Valles Marineris canyon system may be the sites of long-standing, ancient lakes where sediments accumulated over extended periods of time. This, in turn, supports the idea that future rovers could sample ancient sediments deposited by water to reveal whether Mars once had life.

The evidence zeros in on deposits in low spots such as crater floors and the canyon bottom. (All these photos — along with more than 50,000 others — can be seen on the Malin Space Science Systems website at http://mars.jpl.nasa.gov/mgs/.) Images with details as small as 20 feet (7 meters) across show that the deposits consist of smooth layers that were evidently laid down on top of older terrain. Gale crater, for example, has a massive deposit about a mile (2 km) thick that can be seen draping across an ancient crater and channel system on the underlying crater floor.

In the 60-mile (95-km) wide Pollack crater, layered deposits form the famous "white rock" that was first seen by Mariner 9 in 1971. Those deposits, in turn, partly cover an old crater. These relations prove that some process deposited sediments on top of preexisting terrain. Most scientists think that water carried the large volumes of sediment into the crater. Could these features instead be windblown deposits, which usually consist of loose material? Malin and Edgett argue that the deposits form steep cliffs, so they are not loose sand or gravel but resistant material — in other words, sedimentary rock that is at least weakly consolidated.

The layers in some parts of Valles Marineris appear fairly uniform and about 30 feet (10 meters) thick with sharp, steep edges. Water may have ponded in low spots of the canyon, just as water ponds in low spots of the African rift valleys on Earth, which may have formed in a similar way.

An even more intriguing feature of the layers is that, in most cases, they show very few impact craters. This implies that the existing surfaces are geologically young, perhaps only a few

1

Does the night sky leave you in the dark?

Answer the following questions to determine your intergalactic know-how.
(Hint: Download a FREE trial version of Starry Night™ at www.StarryNight.com and cheat.)

1. The "Trifid" is a what?
a. Galaxy
b. Nebula
c. Globular Cluster
d. B-movie monster

2. What is the most distant object you can see with the naked eye?
a. Pluto
b. The Andromeda Galaxy
c. Crab Nebula
d. Isn't that against the law?

3. What are globular clusters?
a. Space dust
b. Twin asteroids
c. Balls of closely packed stars
d. Mom's Awful Cookies

4. Comet Halley is visible from Earth once every how many years?
a. 52
b. 24
c. 76
d. Hup, Hup, Hup

5. Galilean moons orbit which planet?
a. Mercury
b. Jupiter
c. Hollywood

6. The sun travels through how many constellations in one year?
a. 6
b. 12
c. 13
d. The sun moves?

7. Where is M31?
a. Andromeda
b. Perseus
c. Near Chicago

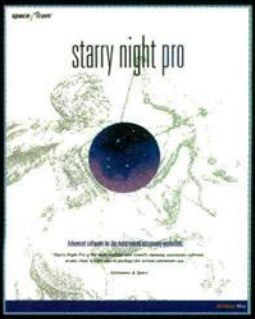
8. What is another name for the North Star?
a. Polaris
b. Sirus
c. Celine Dion

9. Which of the following isn't a nebula?
a. Crab
b. Veil
c. Orion
d. Moose

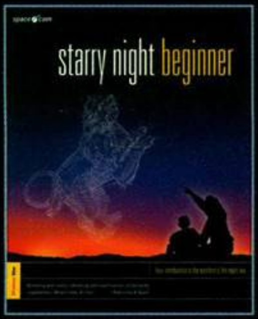
ANSWERS:
1(b), 2(b), 3(c), 4(c), 5(b) 6(c), 7(a), 8(a), 9(d)

2

Let Starry Night™ be your guide.



space.com
starry night backyard



starry night pro. Advanced software for the experienced astronomy enthusiast. Visually stunning, this CD has all the data you need to guide you to all the planets, stars, constellations and over 70,000 galaxies. Comes complete with a free 200 page guidebook to navigating the stars.

➤ Starry Night Pro $129.95

starry night backyard. Discover the Universe on your desktop. Sharing the same visual accuracy as Starry Night Pro, this CD will help you identify planets, stars and constellations using binoculars or the naked eye. Backyard (SE) also comes with the free 200 page guidebook.

➤ Starry Night Backyard $49.95 ➤ (SE) $59.95

starry night beginner. Your introduction to the wonders of the night sky. Starry Night Beginner conveys the invigorating experience of being out in the countryside standing under a canopy of stars on a still night. It's perfect for anyone learning their way around the night sky.

➤ Starry Night Beginner $29.95

3

Order now from www.StarryNight.com or call (800) 221-8180

Take an online tour at www.StarryNight.com/tour

Starry Night is now published by space.com™

© 2000. SPACE.com Canada, Inc. All Rights Reserved

million years old or less. From what we know about Mars, it seems unlikely that sediments laid down by water could have formed so recently. Instead, their appearance suggests that these are ancient sediments that have been recently exposed by processes that geologists call exhumation. Winds on present-day Mars, for example, might carry away crumbly materials that have eroded out of weak surface sediments, just as winds can strip away terrestrial soils and expose underlying ancient layers.

The exciting implication is that some of these layers may be 4-billion-year-old sediments from the ancient, water-rich days of early Mars — and they may be preserved in pristine condition. If Mars had any living organisms during its hypothetical early watery period, their fossil imprints or even organic remains might be contained in such sediments.

The sediments fit in with other evidence from Mars Global Surveyor that Mars had a watery past. They also offer a dramatic target for future lander, rover, and sample-return missions to test theories about ancient life on our neighbor.

Mars Global Surveyor could play a key role in deciding where such future missions may land. NASA recently agreed to extend the mission until April 2002. Originally scheduled to map the planet for one martian year (687 Earth days), the spacecraft reached that milestone on February 1, 2001. The extended mission will allow scientists to fill in gaps in the existing coverage and complete a more global reconnaissance. — William K. Hartmann, Planetary Science Institute, Tucson

SOLAR SYSTEM

Twin Asteroid Discovered

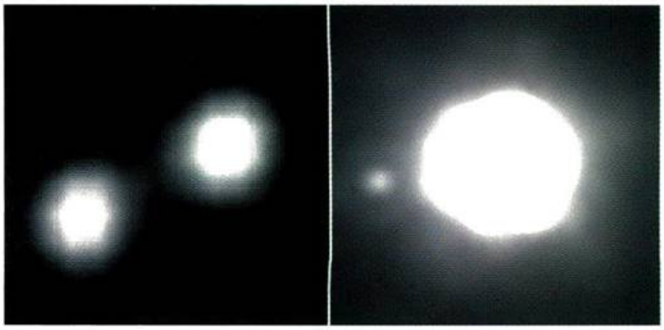
▶ Ever since the discovery of the first asteroid, Ceres, in 1801, most asteroids have remained nothing more than slow moving points of light. Detailed photographs of these remnants from the solar system's birth had been the sole province of interplanetary spacecraft.

Enter an international team of scientists led by William Merline from the Southwest Research Institute (SwRI) in Boulder, Colorado. Merline and his collaborators surveyed about 200 asteroids using adaptive optics with the 10-meter Keck Telescope atop Mauna Kea in Hawaii. To the surprise of planetary scientists, they uncovered the first double asteroid.

The image of 90 Antiope shows two distinct objects, each about 50 miles across and separated by about 100 miles. The two components orbit around their mutual center of gravity.

Planetary scientists long assumed that Antiope was a single body. The discovery raises questions about the origins of asteroids. The same team has also discovered asteroid companions, or moonlets, orbiting 45 Eugenia and 762 Pulkova. When combined with the Galileo spacecraft's discovery of tiny Dactyl orbiting Ida, the total number of known asteroid satellites rises to three, not counting the Antiope twins. "Every new companion we discover seems to bring new configurations and new mysteries," says team member Clark R. Chapman of SwRI.

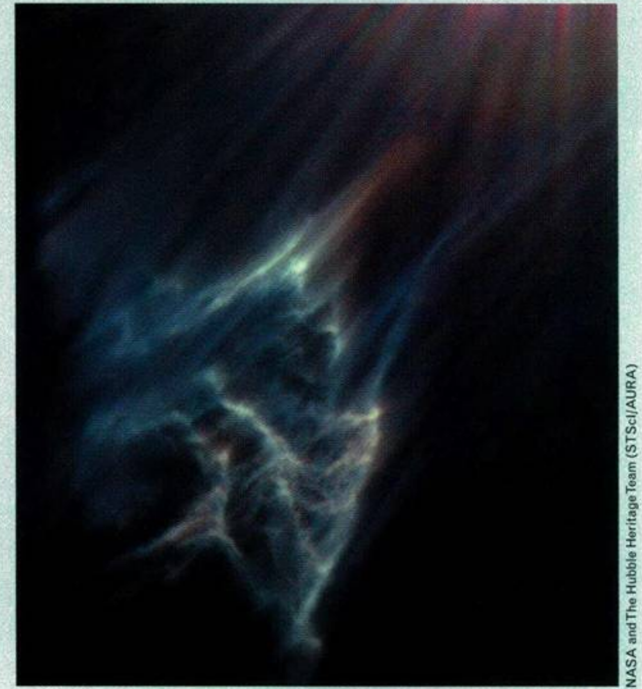
The researchers also demonstrated the power of adaptive optics technology by producing a time-lapse movie of the dumbbell-shaped asteroid 216



High-resolution images show asteroid 90 Antiope (left) to be a twin and reveal a satellite around 762 Pulkova (right).

William Merline (SwRI), et al.

HUBBLE SPACE TELESCOPE



NASA and The Hubble Heritage Team (STScI/AURA)

GHOSTLY TENDRILS OF DUST-LADEN GAS stream away from the bright star Merope in the Pleiades star cluster. Starlight from Merope, which lies off the upper right edge of this Hubble image, reflects off the dust and gives the reflection nebula a bluish color. The starlight also exerts "radiation pressure" on the dust, slowing down smaller particles more than larger ones and helping to segregate the particles by size (the larger particles lie closer to the star). The nebulosity is an independent cloud now drifting through the Pleiades at a relative speed of about 7 miles per second (11 km per second).

Telescope Accessories

Huge Selection Galore! Great Low Prices

Ultrascopic™ Eyepieces
From $79

Glass Solar Filters
From $54.95

17 Amp-Hour Field Battery
$109

New!

ORION
Tri-Mag

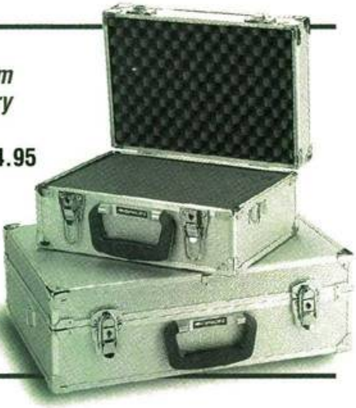
Tri-Mag™ 3x Barlow
$44.95

Sirius™ Plössl Eyepieces
Most $49.95

Save on Sets!

PLÖSSL 10mm
PLÖSSL 26mm
PLÖSSL

Deluxe Aluminum Accessory Cases
From $24.95



EZ Finder Reflex Sight
$39.95

ORION EZ Finder

Deep-Map™ 600 Folding Star Chart
$13.95

ORION
DEEPMAP
600
The Deep-Sky "Road Map" for Amateur Astronomers
Map by Wil Tirion

ORION
LaserMate

LaserMate™ Laser Collimator
$69.95

Fully Padded Scope Cases
From $29.95

New Low Price!

SkyGlow™ Light-Polution Filters
From $59.95

ORION SkyGlow Filter

Red Beam™ LED Flashlight
$11.95

RedBeam LED
ORION TELESCOPES & BINOCULARS

Orders/Free Catalog ORION TELESCOPES & BINOCULARS **(800)447-1001**

telescope.com

Our 26th Year!

Kleopatra as it rotated. Radar observations made by Steve Ostro of the Jet Propulsion Laboratory when the asteroid was fairly close to Earth had revealed Kleopatra's "dog-bone" shape. Adaptive optics with the Keck Telescope confirmed that the technique can tell the difference between a dumbbell shape and a twin asteroid.

Perhaps most surprising is that Antiope is the only double asteroid discovered so far in the survey. "In fact, asteroidal satellites and twin companions are rather rare," says Merline, who presented the new results last October at the annual meeting of the American Astronomical Society's Division for Planetary Sciences in Pasadena, California. "It's possible that a few more moonlets might emerge from more sophisticated analysis of the trove of data we have collected," he adds. — Martin Ratcliffe

STARBURST GALAXIES

Black Holes Act as Midwives

▶ Out of darkness, there comes light. At least that's what seems to be happening in the core of some galaxies, where supermassive black holes may be triggering massive bursts of star formation. Nancy Levenson of Johns Hopkins University and her colleagues reported their findings at the November meeting of the American Astronomical Society's High Energy Astrophysics Division held in Honolulu, Hawaii.

The team found a strong link between galaxies where stars are forming at a high rate and galaxies containing central, supermassive black holes devouring large amounts of surrounding material. Most astronomers had thought these were two separate phenomena.

"The process that makes the central black hole in a galaxy grow more massive may help trigger these bursts of star formation," says Levenson. "A starburst phase may be a common stage of development for Seyfert galaxies and quasars, two of the most luminous objects astronomers see in the distant universe."

Seyfert galaxies possess many of the same characteristics as quasars. At the center of these objects lies a supermassive black hole that swallows stars and gas from a region about the size of our solar system. Before it gets consumed, however, this material forms an accretion disk around the black hole, where friction heats the matter to millions of degrees. That's what drives the tremendous energy output. In a so-called Seyfert 1 galaxy, the radiation comes out unimpeded, while in a Seyfert 2, it is partially obscured.

The Seyfert 2 galaxy M77 in Cetus harbors a central black hole and regions of high star formation. AURA/NOAO/NSF

Levenson's team studied the x-ray emission from 14 Seyfert 2 galaxies and found that they showed regions of high star formation just outside the central area, as well as the classic emission from the black hole's accretion disk in the nucleus. "Something must be tugging on the material in a starburst region and increasing the chance that the gas there will collect and form stars," says Levenson. "In the Seyfert galaxies, the gravity of the central black hole could be helping to do this."

The new results may also help explain the difference between the two types of Seyferts. The starburst regions in a Seyfert 2 could help obscure the galaxy's central region. Once the starburst ages several million years, however, its many massive stars will have died as supernovae. Those explosions could sweep away the leftover gas and dust and yield a clear view into the galaxy's core seen in a Seyfert 1. — Richard Talcott

COSMOLOGY

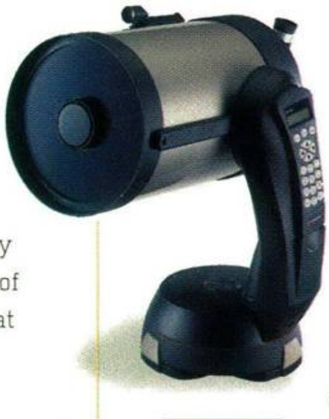
The Fall of Cold Dark Matter?

▶ Cold dark matter — a cosmological Holy Grail long sought after to explain the universe's structure and fate — may have been rendered irrelevant. If so, it's due in large part to some innovative models of the early universe and their subsequent application to recent data retrieved from a high-altitude Antarctic balloon experiment.

In 1998 and 1999, BOOMERANG (Balloon Observations of Millimetric Extragalactic Radiation and Geophysics) surveyed 3 percent of the sky for remnants of minute temperature fluctuations in the early universe. (See "Unveiling the Flat Universe," August 2000.) Cosmologists were relieved to find that the balloon telescope's observations of the cosmic microwave background showed that the geometry of spacetime is flat. But they were surprised to discover that the data also supported the models of Stacy McGaugh, a 36-year-old University of Maryland astronomer, that suggest dark matter may be only a high-concept retelling of the fable about the emperor's new clothes.

The idea that 90 percent or more of the universe's mass might be in the form of dark matter comes from observations that the stars and gas in most individual galaxies rotate about the galaxy's center at the same rate and that galaxies in clusters move too fast to stay bound. The existence of large amounts of dark

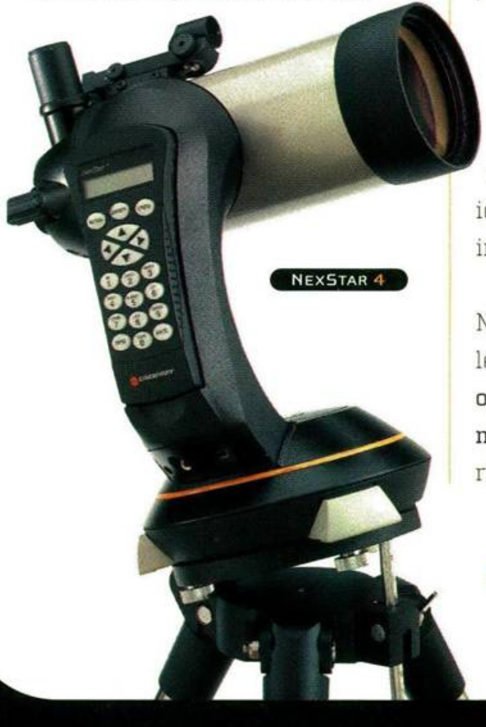
The Universe Is Full Of Mysteries. Using A NexStar® Isn't One Of Them.



NEXSTAR 8

The joy of stargazing comes from observing the wonders of the heavens, not calculating alignments and positioning. The revolutionary new Celestron® NexStar™ line of telescopes does all that for you and more. Simply and easily.

NexStar™ telescopes are light years ahead of other computerized "Go-To" telescopes. The **Auto Align** feature gets you up and observing immediately with an enormous object database that includes up to 18,000 celestial sights. Peer through the **StarPointer**™ finderscope and quickly find any object in the sky, while variable slew speeds provide easy tracking for observation and astrophotography. There's even a communication port so you can control the NexStar™ from your personal computer.



NEXSTAR 4

The newest member of the NexStar line, the NexStar 4, features high-quality **Maksutov-Cassegrain** optics and an optional tripod-wedge making it the most ideal telescope for astrophotography in its class.

The advanced NexStar 5 and NexStar 8 models feature the legendary **Schmidt-Cassegrain optical system** plus **Starbright**™ **multi-coatings** for superior resolution and optical clarity.

Best of all, our **Tour Function** automatically seeks out the most spectacular objects in a given month, while providing you with fascinating facts through the Hand Controller.

NEXSTAR 5

NexStar telescopes are designed to go with you anywhere and perform beautifully. Using the same optical tube selected for the Space Shuttle, each NexStar gives you unsurpassed performance.

With the most advanced and comprehensive "Go-To" telescope line available, the only mystery is which NexStar™ to choose.

CELESTRON®

FIND OUT MORE ABOUT NEXSTAR, OUR OTHER EXCEPTIONAL TELESCOPES, AND NEARBY DEALERS.

(310) 328-9560 • www.celestron.com

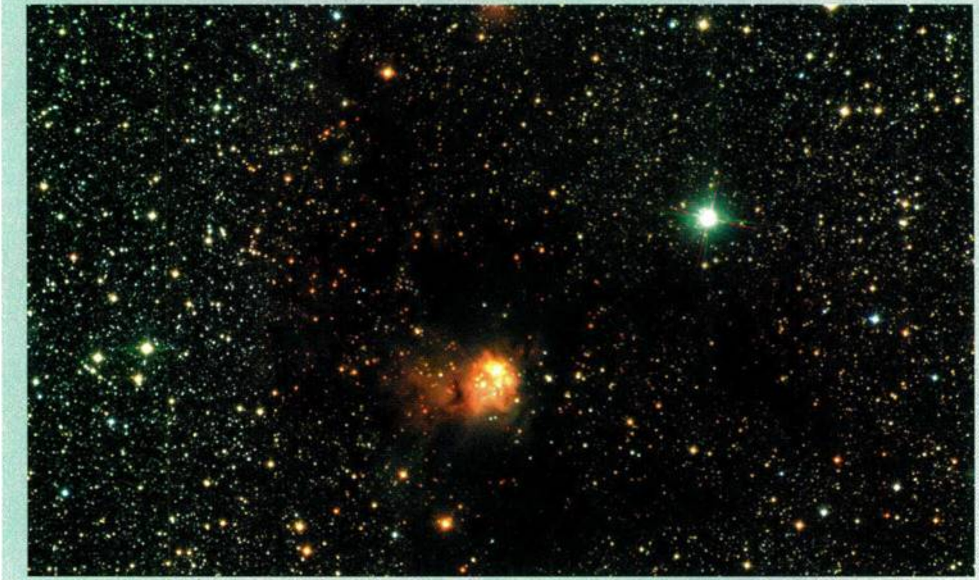
©2000 CELESTRON INTERNATIONAL

matter nicely explains these observations.

McGaugh had also been a believer in dark matter. But in 1994, he noticed that dark matter could not explain the rotation of several low-surface-brightness galaxies. Not long after, he heard a talk by Mordehai Milgrom, a physicist at Israel's Weizmann Institute and a controversial proponent of Modified Newtonian Dynamics (MOND), a theoretical alternative to the need for dark matter. For MOND to work, scientists must take a leap of faith and accept that during infinitesimally small accelerations, a hundred million times less than Earth's acceleration around the sun, Newton's second law of motion (force equals mass times acceleration) ceases to apply. The end result: Less mass is needed to create the large observed accelerations.

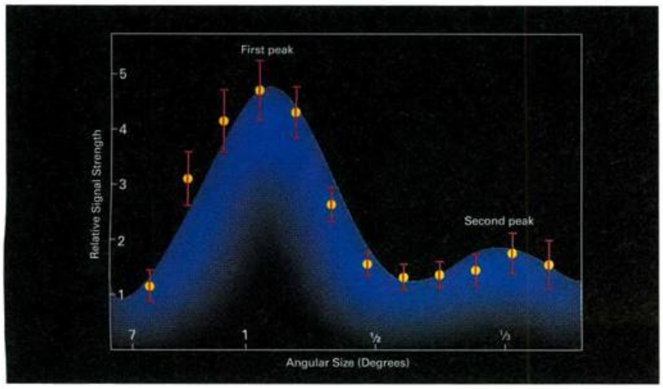
McGaugh applied MOND to his own data and found that it worked extremely well. But most cosmologists dismissed his results, saying they would only consider writing off dark matter if the microwave background radiation did something "weird." So, in 1999, McGaugh took them at their word and published predictions for the strength of the microwave background at various angular sizes. He theorized that if cold dark matter existed, the secondary peak at a size of about ⅓° would be fairly prominent compared with the main peak at 1°. If cold dark matter didn't exist, then the second peak would be roughly a fifth as high as the first. McGaugh believes that because cold dark matter is unlike ordinary matter, it would not have interacted with the photons of the microwave background when they were created some 300,000 years after the Big Bang, causing a higher secondary peak. Normal matter would depress the second peak.

NEW TECHNOLOGY TELESCOPE



European Southern Observatory

DEEP INSIDE A DENSE CLOUD of gas and dust, a new generation of stars begins to emerge. This wide-field infrared view shows the RCW 108 complex, a dark cloud located about 4,000 light-years from Earth in the southern constellation Ara. The bright emission region just below center, cataloged as IRAS 16362–4845 and a hotbed of star formation, appears bright because the young stars in it heat the surrounding dust, which glows strongly in the infrared. RCW 108 appears silhouetted against the rich background of the Milky Way, whose stars are mostly hidden by the dusty cloud. The dust also scatters shorter-wavelength light out of our line of sight more effectively, so the stars that do shine through appear redder. This image consists of some 600 individual exposures taken at three different infrared wavelengths with the European Southern Observatory's 3.6-meter New Technology Telescope in La Silla, Chile.



The second peak in the microwave background radiation, at an angular size of about ⅓°, is smaller than expected and may eliminate the need for cold dark matter. BOOMERANG Collaboration

McGaugh's models of a universe without dark matter matched BOOMERANG's results almost perfectly. Yet Vera Rubin of the Carnegie Institution of Washington, who in the 1970s first observed the unexpected rotation rates of galaxies, argues that the jury is still out on both cold dark matter and MOND. "I don't think we know what's right at present," she says. "We live in a complicated universe. It looks like it's flat, but I wouldn't drop dead if five years from now we learned it was something totally different."

— BRUCE G. DORMINEY

JMI's (www.jimsmobile.com) Hot Products Showcase
INVENTORY REDUCTION SALE

Nexstar 8 Case
With Diecut Foam

New Nexstar 8 Case

Custom Designed By JMI
Sleek & Compact,
with Wheels (no discounts)

$249(\$14)

BEST FOAM IN THE INDUSTRY

- Holds 6 eyepieces.
- Professional Die-Cut Foam Lining -Top & Bottom (No cubes to fall out).
- Compartment to hold eyepieces, hand controls, etc.

Foam Lined Carrying case

TAKE \$20 OFF

ETX 125-EC	\$149.95 (\$8)
NextStar 5	\$149.95 (\$8)
EXT-90, ETX-90EC	\$109.95 (\$7)

Now available for ETX 125

MEGAPOD

- Convenient storage for your eyepieces
- Convenient holder for your Autostar
- Adjustable legs with bubble level
- NO fumbling to get screws into blind holes – Telescope slides into place

TAKE \$20 OFF

$229(\$14)

The MEGAPOD has blinking red lights at the tips of the feet to prevent accidentally bumping the legs. (The last thing you need is to do a computer star realignment because your telescope accidentally got bumped.) A toggle switch activates the lights.

Megapod now with polar alignment tube

Folds to 31" – Extends to 50"
Adjustable with latitude scale (0⁰ to 90⁰).

***MEGAPOD* for ETX-90, ETX-90EC, ETX-125EC, NexStar5 \$229.00(\$14)**

SOLID STEEL
Made in the U.S.A.

- **SOLID AS A ROCK**
- ***FLASHING RED LIGHTS***

The only tripod that won't trip you up!

ZERO Image Shift Focuser

"To put it bluntly, if there's a better line of commercial focusers made for imaging, I don't know about it."
Dennis di Cicco
3/94 Sky & Telescope

NGF-DX1 2" with 1.25" adapter (lifts 12lb.)	**\$259.00**(\$7)
NGF-DX2 2" with 1.25" adapter (lifts 10lb.)	**\$199.00**(\$7)
NGF-DX3 2" with 1.25" adapter (lifts 5lb.)	**\$159.00**(\$7)
NGF-mini2 1.25"	**\$129.00**(\$7)
NGF-mini3 1.25"	**\$99.00**(\$7)
DRO (digital focusing)	**\$229.00**(\$7)
DFC	**\$59.95**(\$7)
MOTOFOCUS when ordered with focuser	**\$100.00**(N/A)

New Instafast Focus

for the ETX 125

Electric focus with manual overide

Don't get stranded, focus your scope even after the batteries are dead.

Introductory Special **\$99.95(\$6)**

Breakthrough Design from JMI "GoTo" SYSTEM FOR OBSESSION

JMI Nightrider TRACK-N-GO™

Nightrider must be purchased directly from JMI or Obsession Telescopes only.

Nightrider for Obsession telescopes \$1995.00 (\$20)
In stock now for 15" and 18".
Other models coming soon. Watch the Web.

Schmidt–Cassegrain Focuser

Manual version of JMI's famous
Zero–Image–Shift NGF–S focuser

NGF–SE Manual Focuser	**\$169** (\$7)
NGF-S for **SCTs** - This special version of our **NGF** focuser fits directly on to 2" thread of Meade and Celestron 8"-14" Schmidt Cassegrain telescopes.	
NGF-S w/built-in **MOTOFOCUS**	**\$269** (\$7)

TAKE \$10 OFF

Fits all Meade scopes with standard field tripod. (not 12")

ORGANIZER/ WORK STATION

Work station can rotate 360⁰. Holds four 2" and four 1 1/4" eyepieces as well as hand control.

Organizer/Work Station \$99(\$11)

MEGAWEDGE!

- It holds the **ETX–90 Astro/EC–90, ETX–125, NexStar 5, NexStar 8.**
- Fits **NexStar 5/8 tripod** & **Meade field tripod.**

Holds 6 eyepieces

$129(\$11)

TAKE \$20 OFF

NGT-18 Split-ring equatorial 18" f/4.5 **\$12,900**

NGT-6 Split-ring equatorial 6" f/4.5 **\$999**

NGT-12.5 Split-ring equatorial 12.5" f/4.5 **\$4,900**

Call Now
1-800-247-0304
Visa & Mastercard accepted.

(www.jimsmobile.com)
Prices are subject to change

Jim's Mobile Inc. • 810 Quail St. Unit E • Lakewood, CO 80215 • Orders: 800-247-0304 • Info: 303-233-5353 • Fax: 303-233-5359

COSMOLOGY

Survey Finds Huge Clusters

Like dalmatians in the classic Disney movie, huge galaxy clusters in the distant universe seem to be multiplying out of control. And in an odd case of life imitating art, astronomers working on a new survey have so far uncovered 101 of these behemoths. The enormous number — far more than previously suspected — implies that the universe quickly reached a state not too different from what it is today.

Although thousands of massive galaxy clusters have been cataloged in the nearby universe, earlier surveys had found only a handful of distant ones. (These mammoth structures contain hundreds, if not thousands, of galaxies, each of which holds many billions of stars.) Because looking deeper into space means looking further back in time, astronomers had concluded that massive clusters formed fairly recently in the history of the universe, perhaps within the past 3 billion years.

That's all changed with the Massive Cluster Survey (MACS). "MACS has been extraordinarily successful at finding the elusive, massive, distant galaxy clusters," says team leader Harald Ebeling of the University of Hawaii.

Ebeling and his colleagues report that the survey is now more than three-quarters complete and they have found 101 clusters. The clusters lie more than 5 billion light-years from Earth, so they started to form when the universe was only half its current age. The team announced the results at the November meeting of the High Energy Astrophysics Division of the American Astronomical Society in Hawaii.

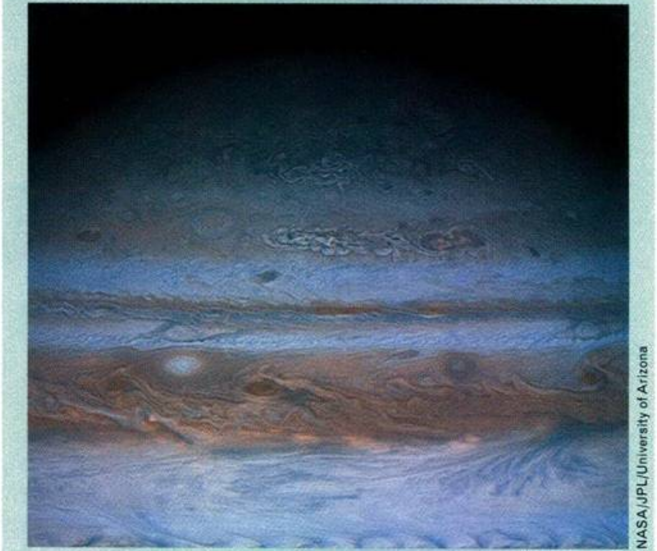
Once the survey's results have been completely analyzed, MACS should yield an accurate measure of the density of the universe. The observations already show that the density isn't high enough to stop the universe from expanding forever, a result that agrees with other recent studies.

The survey's data came from the ROSAT x-ray satellite, which completed its mission in December 1998. The archived observations from the ROSAT All-Sky Survey proved indispensable for detecting the clusters. Massive clusters contain enormous amounts of gas at temperatures of hundreds of millions of degrees. The gas shows up easily in the x-ray part of the spectrum but remains invisible to optical telescopes.

As the MACS team works to complete the survey, other observatories have started targeting the newly discovered clusters. The orbiting Chandra X-ray Observatory, the 10-meter Keck and 8-meter Subaru telescopes on Mauna Kea, and the nine radio telescopes belonging to the BIMA array in northern California have all begun detailed studies. The observations should play an important role in the debate about the distribution of matter and the ultimate fate of the universe. — R. T.

This large, distant galaxy cluster is one of more than 100 discovered by a new survey. H. Ebeling, et al.

CASSINI AT JUPITER



NASA/JPL/University of Arizona

JUPITER POSED FOR CASSINI as the spacecraft approached this past December. This true-color image, which has also had its contrast enhanced and its edges sharpened, was taken on the 13th — about two weeks before Cassini's closest approach — from a distance of 11.8 million miles (19.0 million km). Even at this distance, the spacecraft's camera was delivering sharper images of Jupiter than the Hubble Space Telescope. This view captures the north polar region of the planet. Unlike the equatorial and mid-latitude regions, where bright zones alternate with darker belts to produce the familiar banded appearance, the high-latitude areas appear mottled. The intricate structures seen represent clouds of different heights, thicknesses, and chemical compositions.

2 GREAT LOCATIONS

Penna.-POCONO MOUNTAIN OPTICS

ORDERS: 800-569-4323
INFO: 570-842-1500

Las Vegas-POCONO WEST OPTICS

ORDERS: 800-635-3607
INFO: 702-252-7200

POCONO GLADLY ACCEPTS: *with no surcharge*

$7.00 MINIMUM SHIPPING/ UPS (in U.S.)

- Purchase Orders from Qualified Institutions Gladly Accepted
- We Purchase and Take In Trade Used Telescopes

Visit Our Two Showrooms in Moscow, PA and Las Vegas NV!

We carry the following lines & products for all of your astronomical needs: See online or printed catalog for full details:

ACCESSORY CASES
ADIRONDACK VIDEO
APOGEE
APOGEE INSTRUMENTS
ASTROMETRICS-GO TO SYSTEMS
ASTRO SYSTEMS
12-VOLT BATTERIES
BRANDON
BUSHNELL
CELESTRON
COLLINS ELECTRO OPTICS
CORONADO H-ALPHA SYSTEMS
DESERT STORM COVERS
FUJINON BINOCULARS
HOMEYER FLIP MIRRORS
JMI
KENDRICK
LASER MAX
LOSMANDY
LOMO
LUMICON
MEADE
OPTEC
PARALLAX
PENTAX
QUESTAR
RIGEL SYSTEMS
SBIG
SOFTWARE BISQUE & SOFTWARE
TAKAHASHI
TECH 2000 DOB DRIVERS
TECTRON
TELE VUE
TELRAD
THOUSAND OAKS SOLAR FILTERS
UNIVERSITY OPTICS
POCONO SPECIALS & MORE

COMPUTER SOFTWARE

"THE SKY" by Software Bisque

CCD Soft	$219.00
Starry Night Deluxe	$89.95
Star Chart 3	$39.95

The Sky, Level 4 Version 5 Now Available.

Max DL Imaging Software..$365.00

OBSERVE IN COMFORT with STAR-BOUND VIEWING CHAIR

- Portable, Adjustable from 9" to 32"
- Padded Seat
- Porcelain Black Powder Coated Available in Black or White

Dealer Inquiries Invited **$159.00**

TELRAD w/Base $39.00

Batteries included!

Hinged Deluxe Dew Caps	$10.00
Extra Bases	$ 7.95
Extra Reticles	$ 2.95
Pulsar Unit	$19.95

RIGEL SYSTEMS

Starlite Dual LED Flashlight	$22.00
NEW Skylite: Dual Color LED Flashlight	$29.95
Quick Finder-New Version	$35.00

KENDRICK ASTRO INSTRUMENTS

Stay ahead of those soggy fall nights!

The Kendrick Dew Remover System for all size scopes, finders and mirrors

Keeps optics clear of dew, extending precious viewing time.

VISIT OUR 50+ PAGE ON LINE CATALOG WITH SECURED 24 HOUR ON LINE ORDERING AT: www.PoconoScopes.com

Look for our Monthly On-Line Specials! Call or write for our printed catalog & specials.

YOUR MEADE AUTHORIZED ADVANCED PRODUCTS MAIL ORDER DEALER

Meade Dobsonians: Available in: 6"F/8, 8"F/6,10" F/4.5, 12.5" F/4.8, 16" F/4.5, optional deluxe accessory package $49.95

New Meade ETX-90/EC and ETX-125/EC-with pushbutton electronic control comes standard with dual-axis drive system W/4 dual axis speeds. Add the Meade Autostar hand control to your scope and get fully automatic go to capability to over 12,000 objects. The ETX-125/EC has 5" of Aperture & RA Finder. Available Now.
ETX-90/EC $595.
ETX-125/EC $895.
Original ETX-90 RA $495.

ALL DS SCOPES AVAILABLE

Meade LX-200 SCT's,The World Famous "GoTo" Telescope Available in 8" F/10 or F/6.3, 10" F/10 or F/6.3, 12" F/10, 16" F/10.

ACCESSORIES FOR ETX-90 RA, EC, 125EC	
#126 Barlow	$47.95
#64 T-Adapter	$34.95
#932 Image Erect Diagonal	$49.95
Hard Case for 90	$99.95
Soft Case for 90 RA & EC	$39.00
07329 #775 Hard Case for ETX-125EC	$155.00
8X25 right Angle Finder for 90	$49.95
Auto Star Hand Control for 90 &125 EC	$149.00
Equatorial Table Top Tripod (w/Hi Lat Leg)	$29.95
Equatorial Table Top Tripod (w/Hi Lat Leg) for 125 EC	$55.00
Deluxe Field Tripod	$199.00
07077#1244 El. Focus for all ETX-90's	$119.95
07078 #1247 Elect. Focuser-ETX-125EC/S.scope	$119.95
DS SERIES ACCESSORIES	
07437 #495 Autostar (hand box only)	$99.
07438 #492 Dual Motor Elect. Control System	$129.
07439 #493 Autostar, Complete System	$199.
07076 #1240 Elect. Focuser	$75.
07041 #490 Elect. Focuser	$75.
07221 #937 2" Diagonal Mirror w/.96 & 1.25" Ad.	$45.
Meade 8" LX-10	**$995.**
Super Wedge	$395.
New Field Derotator for 8", 10",and 12" SCT's, and 7" Maksutov	$395.

New ETX-60 $299.& New ETX-70 $349. Now Available

NEW
8" LX-90 SCT $1695.

World Renown Series 4000"Eyepieces
Complete line in stock for immediate delivery!
NEW Meade Series 4000 8MM to 24MM Zoom Eyepiece $219.95

Tele Vue "WHEN YOU WANT THE FINEST"

We stock the entire Tele Vue line for immediate shipment. All items also on display and available for purchase and pick up at both of our showrooms.

NAGLERS 82° Apparent Field of View
Choose from 4.8 MM $175., 7 MM $220., 9 MM $240.,16 MM $310.
New Type 4 12MM Nagler $340.
Orders now being accepted for the 17MM and 22MM Type 4 Naglers
Type 5 31 Nagler $595

RADIANS 60° Apparent Field of View, 20 MM eye relief
Avail. in 3, 4, 5, 6,8, 10. 12. 14. & 18 MM $228.00
PANOPTICS 68° Apparent Field of View
15MM $210., 19MM $240., 22MM $280., 27MM (2") $330., 35MM (2") $365.

MONTHLY SPECIAL
PRONTO w/2" DIAGONALPanoramic Mount and Quick Point Finder
POCONO MOUNTAIN OPTICS EXCLUSIVE

2.5x Powermate	$168.00
5x Powermate	$168.00
New 4x Powermate now avail. $265.	
New Bino Vue	$1030.00
8MM to 24MM ZOOM	$210.00
New Everbrite 2" Star Diag.	$255.00

***NEW* TV-102 In Stock $2150.**

Ranger, Pronto, TV-85 in stock

CELESTRON *We carry the full line of Celestron Telescopes and Accessories*

NEW NEXSTAR 5 & 8

JUST ARRIVED! **Flawless go-to and tracking. Superb optics, very quiet. A real winner! Nexstar 5 $1199. Nexstar 8** (w/tripod) **New Low Price $1699!**

CELESTAR 8 DELUXE

2032 MM FL., Heavy Duty Adj. Tripod Dec Motor and Hand Control. 4 Tracking Rates and PEC Fastar Compatable. In Stock for Immediate Shipment. $1699. Celestar 8, reg. version $1099.

ULTIMA 2000

Ultra Quiet Motors and Go To Impressive Pointing Accuracy. Runs off 8 AA Batteries. Enhanced Encoder Resolution. Fastar Compatable at F-2 for CCD use. 9X50 Finder. In Stock and Impressively Priced. $2699.

DESERT STORM COVERS

Protect your investment-
Covers available for all size scopes.
Manufactured with a thick mylar "heat resistant" material

4"- 6" Dobs & SCTs	$21.95
7" -8" Dobs & SCTs	$26.95
10" -13" Dobs & SCTs	$32.95
14" SCTs	$38.95
16" -18" Dobs	$44.95
20" -25" Dobs	$54.95

Dealer Inquiries Invited

ORDERING & SHOWROOM HOURS

Penna.-POCONO MOUNTAIN OPTICS
Order: 9-9 Mon.-Fri., 9-5 Sat., 12-5 Sun.
Showroom: 10-5 Mon.-Sat., 12-5 Sun.
Las Vegas-POCONO WEST OPTICS
Order: 9:30-6 Mon.-Fri., 10-5 Sat.
Showroom: 9:30-6 Mon.-Fri., 10-5 Sat.
Prices and specifications subject to change

Penna.-**POCONO MOUNTAIN OPTICS**
104 N P 502 Plaza, Moscow, PA 18444
FAX NO. 570-842-8364 Visit our Website at: www.PoconoScopes.com
E mail: pmo@PoconoScopes.com

Las Vegas-**POCONO WEST OPTICS**
2580 S. Decatur #3, Las Vegas, NV 89102
FAX NO. 702-252-7130 Visit our Website at: www.PoconoScopes.com
E mail: pwo@PoconoScopes.com

Mention Ad A-7

Paul Young

OBSERVATORIES

Seeing Red on Mount Graham

▶ Despite predictions to the contrary, studies show that the red squirrel population around the Mount Graham International Observatory (MGIO) has increased over the past decade. Construction of the MGIO, financed by the University of Arizona with a number of other national and international parties, began in 1987 after facing heavy protests from environmental groups.

Environmentalists argued that this endangered red squirrel subspecies (*Tamiasciurus hudsonicus grahamensis*), endemic to the Mount Graham area in the Coronado National Forest in southeastern Arizona, might become extinct if the telescopes and their associated buildings were constructed. Instead, researchers have found that fluctuations in the squirrel population parallel the available food supply — which depends upon the health of the mixed conifer and spruce fir habitat zones on Mount Graham.

Biologists consider the Mount Graham Red Squirrel an "island" subspecies, which makes it especially susceptible to habitat destruction.

The number of endangered Mount Graham Red Squirrels rose in the 1990s despite observatory construction on the mountain.

Researchers estimate the total squirrel habitat on Mount Graham at 10,000 acres. Overall, the construction of the MGIO — which currently contains the Vatican Advanced Technology Telescope, the Heinrich Hertz Submillimeter Telescope, and the under-construction Large Binocular Telescope — permanently removed or destroyed 8.6 acres of the 24-acre area designated for the telescopes.

A pending lawsuit filed in June 2000 on behalf of several Native American and environmental groups and individuals maintains that a proposed 23-mile (37-km) long buried power line to the summit area will further harm red squirrel habitat. Proponents say the power line will replace the frequent truck shipments of diesel fuel needed for generators and eliminate the possibility of an environmentally damaging oil spill from a motor-vehicle accident.

And while astronomers plan to build four more telescopes on Mount Graham in the future, a more insidious threat to the red squirrels' survival looms: Insect infestations may kill most of the old-growth forest within the next few years. Once the trees die, a firestorm fueled by dead timber might not only wipe out a large portion of the squirrels' habitat but also consume the multi-million-dollar telescopes. Either of those outcomes would have backers seeing red.

— Carol Ryback

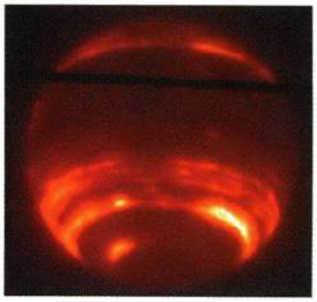
GAS-GIANT PLANETS

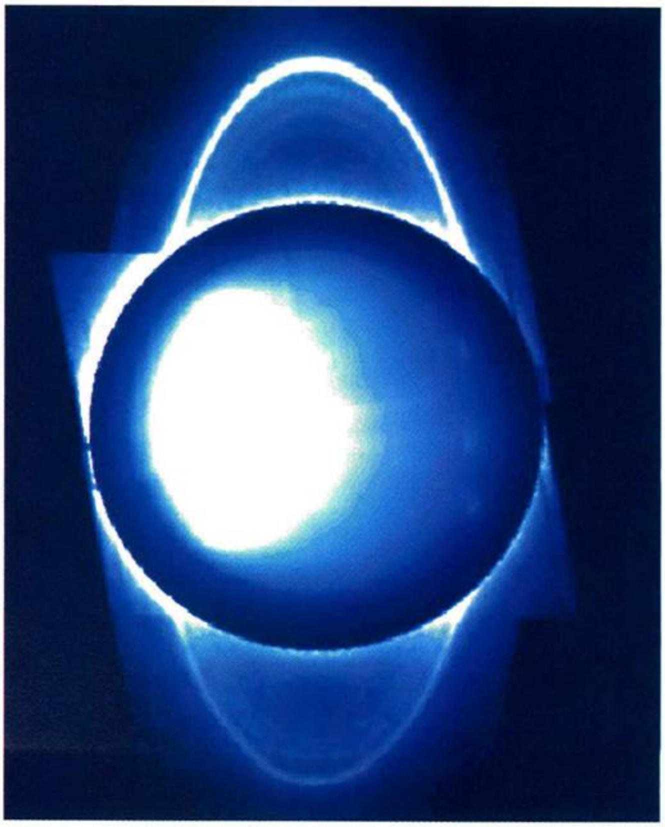
Closeup on Distant Giants

▶ More than a decade has passed since Voyager 2 flew past Uranus and Neptune. At the time, there was no way to follow up on the spacecraft's discoveries, and the observational study of the planets languished.

In the past 10 years, however, the situation has improved. First, the Hubble Space Telescope provided occasional glimpses of the planet at good resolution. Now large ground-based telescopes using adaptive optics to compensate for the blurring effects of our atmosphere routinely yield comparable resolution. The new method may not rival Voyager, but it offers planetary scientists a cheaper way to monitor the planets.

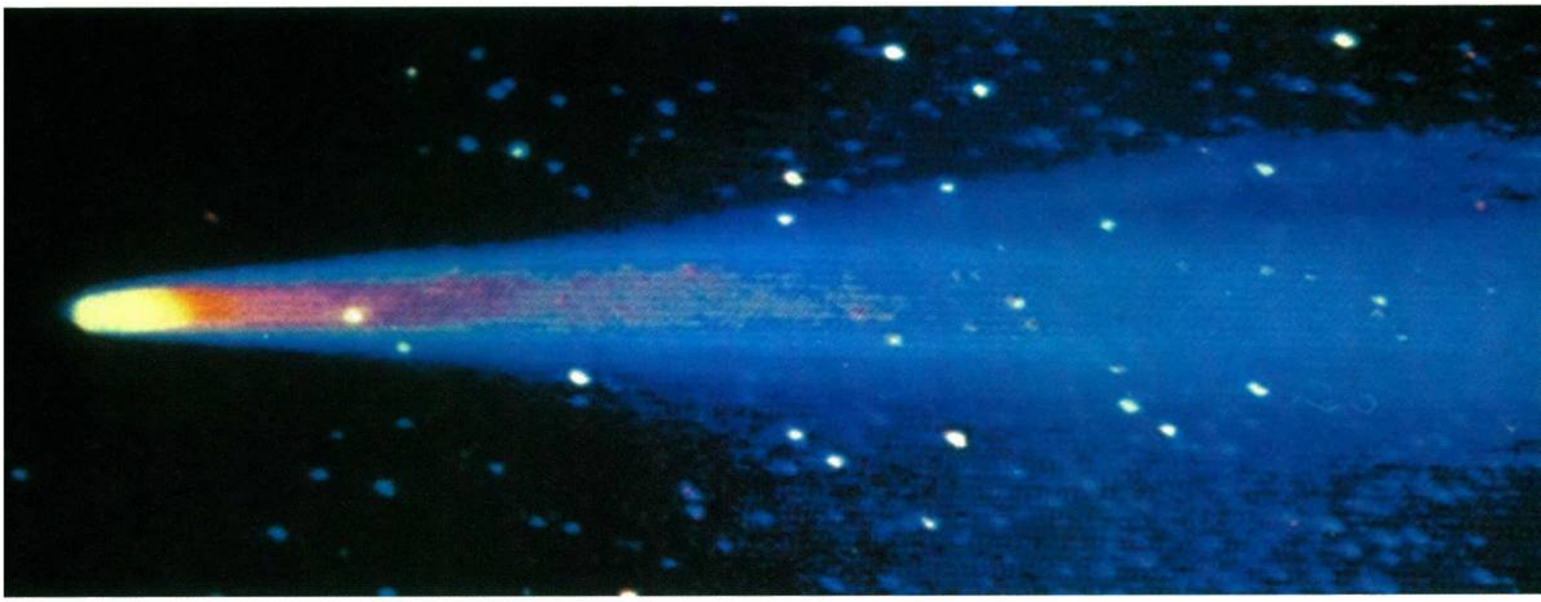
A team of researchers, led by Imke de Pater of the University of California, Berkeley, recently used adaptive optics with the 10-meter Keck II Telescope in Hawaii to capture Neptune in the infrared. "We've never seen the detail we see now," says de Pater. "This shows us how much structure there really is in the atmosphere."





Neptune (left) and Uranus with its faint inner rings (below) stand out in these infrared Keck images.

Imke de Pater (UC Berkeley), et al.



because sometimes you can't be there.

The images easily show the big, bright features, but they also contain a wealth of smaller details: narrow, bright bands that circle the planet, waves within those bands, and regions where the bands move apart and come together.

The team also targeted Uranus, where they detected the planet's faint inner rings — those inside the bright epsilon ring — from the ground for the first time. They also saw several small features in the planet's cloud tops. With the northern hemisphere of Uranus coming out of a 40-year-long period of darkness, many researchers expect the bland atmosphere to erupt in activity. Now that ground-based telescopes can deliver images as sharp as these, we should learn if that's true. — R. T.

PLANETARY SCIENCE

Edge of the Solar System

▶ When ancient mariners set sail into the ocean, their crews no doubt wondered if they might fall off the edge of the world. Astronomers today are more intrigued by real edges, even if they remain elusive, such as where our solar system comes to an end. Now three researchers think they've found the edge, and it's just a stone's throw beyond Pluto.

Lynne Allen and Gary Bernstein of the University of Michigan and Renu Malhotra of the University of Arizona's Lunar and Planetary Laboratory set out to find the edge by looking for distant Kuiper Belt Objects. More than 300 of these objects, remnants of the process that formed the planets some 4.5 billion years ago, have been found in the past 10 years.

Yet none of these lies more than about 55 astronomical units from the sun. (One AU is the average distance from the sun to Earth, or about 93 million miles.) That compares with Neptune's distance of 30 AU and Pluto, which ranges between 30 and 50 AU. The question for the planetary scientists was whether the solar system really ends beyond Pluto or whether more distant objects were simply too faint to be seen.

Keep in mind that the researchers were only interested in where objects formed. So they didn't consider the limit of the sun's gravitational or magnetic influence or the countless comets that orbit far beyond Pluto. Planetary scientists think those comets all formed inside Pluto's orbit and were later ejected.

The team decided to search six areas of sky, each about the size of the full moon, with a state-of-the-art electronic camera. The camera was sensitive enough to pick up any Kuiper Belt Object at least 100 miles in diameter out to 65 AU. They discovered 24 new objects, 9 of them 100 miles across or bigger, but the farthest again lay near the outer part of Pluto's orbit.

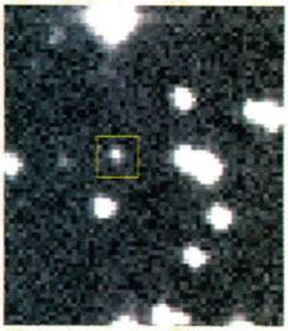
The observations provide the best evidence yet that the apparent edge of the solar system is also a real one. But the researchers don't know whether the primordial solar system was simply small, a passing star stripped away more distant objects, or some other process banished the objects. The debate likely won't be settled as easily as by sailing around the world. — R. T.

Egyptian Error Proves Pyramid's Age

A slight design error in the Great Pyramid of Khufu at Giza — missing a perfect north-south alignment by only 5/100 of a degree — yields the most accurate determination of its age to date. In the November 16, 2000 *Nature*, egyptologist Kate Spence asserts that construction of the monument commenced within five years of 2478 B.C. — lowering previous uncertainty by 95 years. Spence believes that the ancient architects used Mizar (Zeta Ursae Majoris) and Kochab (Beta Ursae Minoris), then on opposite sides of the celestial pole, to find true north. When Mizar and Kochab were vertically aligned over the northern horizon in 2467 B.C., a plumb line to the horizon indicated due north. As the precession of Earth's spin axis caused the pair to move away from the pole, this alignment method steadily lost accuracy. The magnitude of the Khufu pyramid error suggests 2478 B.C. as the construction date.

Pluto Gets a Bright Neighbor

In the pantheon of planets, Pluto rates pretty low in terms of diameter, mass, and orbit — enough so that some planetary scientists suggested demoting it from planethood — but very high in the public's esteem. Neither viewpoint is likely to change with the discovery of a reasonably bright object out in Pluto's neighborhood. During routine scanning with the University of Arizona's 36-inch Spacewatch Telescope last November, observers found a very slow-moving object. Followup observations showed it to be a Trans-Neptunian Object (TNO) located 43 astronomical units from the sun. (One AU is the average Earth-sun distance; Pluto ranges from about 30 to 50 AU.) With a magnitude of 20, the object — designated 2000 WR$_{106}$ — is the brightest of the roughly 350 known TNOs, though more than 100 times fainter than Pluto. Preliminary estimates place its diameter between 330 and 750 miles, compared with Pluto at 1,470 miles.



Spacewatch Project

2000 WR$_{106}$ (square) glows brighter than any other known object beyond Pluto.

Saturn Moons Continue to Multiply

The discovery of six new moons orbiting Saturn apparently wasn't enough (see "Six More Moons for Saturn," AstroNews, February 2001). In December 2000, the prolific team led by Brett Gladman of the National Center of Scientific Research in Nice, France, announced the discovery of six additional moons. That raises Saturn's total to 30, with 12 of those seen for the first time in 2000. All the new moons appear to be small and travel in irregular orbits.

PRECISION SOLAR FILTERS

Recognized around the world for product quality and cutting edge advances, our filters are the preferred choice of telescope retailers and used exclusively by NASA aboard the Space Shuttle. Other professional users include: ABC, BBC,CBS, NBC, CNN, NOVA, The Discovery Channel, National Geographic and most major universities and observatories. Tens of thousands are in use world wide.

TYPE 2+ - Made with high quality hand select glass and coated with our exclusive Solar II Plus. The most durable filter on the market. Transmission is 1/1,000th of 1%. (OD-5). Great for both visual and photographic use. Solar Image is yellow-orange. Guaranteed 15 yrs.

TYPE 3+ - Lighter density, 1/100th of 1% (OD-4) for maintaining fast shutter speeds when using 'slow' fine grain films. For photographic use only. Solar image is yellow-orange. Guaranteed 15 yrs.

POLYMER PLUS - Exclusive *Thousand Oaks Optical* polymer filters offer high resolution at an economical price. Unlike aluminized Mylar, solar image is yellow with better resolution and contrast. Coated on two sides with our exclusive Solar II Plus. Image quality and resolution equals our glass. Guaranteed 10 years.

	TYPE 2+ or 3+		POLYMER PLUS	
APERTURE	Full Aper.	Off-Axis	Full Aper.	Off-Axis
2.4" to 3.1"	$ 69.00	N/A	$ 49.00	N/A
3.5" to 4"	79.00	N/A	59.00	N/A
4.25" to 5"	99.00	N/A	69.00	N/A
6"	109.00	$ 79.00	$ 79.00	$ 69.00
7" to 8"	129.00	89.00	89.00	79.00
10"	149.00	109.00	N/A	89.00
11"	159.00	119.00	N/A	99.00
12" to 13.1"	179.00	139.00	N/A	119.00
14"	199.00	149.00	N/A	139.00
40-80mm Binoc	129.00 pr	N/A	89.00 pr	N/A

NEBULAR FILTERS - Enhance your deep sky viewing with the latest in multilayer coating technology. Our filters transmit desired wavelengths in a very steep slope vs. gentle transition slopes in competitive brands. This means better contrast and overall performance. Made in the U.S. 1.25" - $89 Ea., 2" - $179 Ea.

LP-1 (Broadband) For slight to moderately light-polluted areas.

LP-2 (Narrowband) For heavily light-polluted areas.

LP-3 (Oxygen III) For diffuse and planetary nebulae.

LP-4 (H-Beta) For Horsehead, Calif, & other faint nebulae.

SOLAR ECLIPSE VIEWERS & FILMS - We manufacture a complete line of eclipse viewing devices and thin films including Mylar & our exclusive 'Black Polymer.'

Payment may be made by personal check, bank check or money order. We also accept Visa, MC & AMX. Free brochure available or visit our web site.

THOUSAND OAKS OPTICAL
BOX 4813-A, THOUSAND OAKS, CA. 91359
TOLL FREE ORDER LINE: 800-996-9111
INFORMATION LINE: 805-491-3642
Phone Hours: 10:00 - 5:00 Pacific - Mon-Fri
FAX: 805-491-2393 (24 hours)
www.thousandoaksoptical.com

REACH OUT AND EXPLORE THE NIGHT SKY WITH OUR FAMOUS, AWARD WINNING

ASTROSCAN® WIDE-FIELD 2001 TELESCOPE

The ideal first telescope for your family!

- Award-Winning Compact Design
- Spectacular Extra Wide 3° Field

Astroscan® 2001 Telescope

- Padded Table-Top Base
- Open Sight Target Finder
- 28mm RKE® Eyepiece
- Dust Cap and Carry Strap
- 36 Page Users Manual
- 40 Page "Sky Guide"
- 5 ES Year Limited Warranty

New Lower Price!
$299
#AH02-001

30 DAY MONEY BACK GUARANTEE!

Order online or call toll free
800-728-6999 for FREE CATALOG
www.scientificsonline.com

SCIENTIFICS®
A DIVISION OF EDMUND SCIENTIFIC
Dept. D013-C821, 60 Pearce Ave., Tonawanda, NY 14150
Fax: 716-874-9572 • E-mail: cons_order@edsci.com

ASTRO PIER
Telescope Mounting Piers

Are you tired of leveling and lining up on North? The Astro Pier virtually eliminates vibration from accidental jarring and totally eliminates the need to level and line up on North, allowing for undelayed observing and excellent astrophotography. Constructed from 1/4" and 3/8" welded steel with three 3/4" leveling bolts for excellent performance.

Mounting piers for Schmidt-Cassegrain, Refractors and Newtonian.

Color: Midnight Blue, Black or White

LE SUEUR MANUFACTURING CO., INC.
3220 Loma Road
Birmingham, Alabama 35216
Phone (205) 822-0720
Starting at $321.00 plus S/H

VISA/MASTERCARD NO C.O.D.s

WEBSITE: WWW.ASTROPIER.COM

Rivers CAMERA SHOP

"Call for our informative catalog"

AUTHORIZED MEADE® APD MAIL-ORDER DEALER

Meade LX200'S on display

8" LX200 $2,295 +105 P&S

New Lower Price!

Meade DS-127EC

$499.95 +30 P&S

Meade
ETX-125/EC
$895.00
+30 P&S
in stock!

ETX Accessories
#126 2x Barlow $47.95
#64 Camera Adapter $34.95
ETX Tripod $199.95

Most Meade Products In Stock & On Display!

- Meade Starfinder
- Dobsonians & Equatorials
- ETX 60 + 70 AT
- DS70, DS80, DS90, DS114, DS127
- Meade Series 3000 and 4000 Eyepieces
- Most other Meade accessories in stock

Phone: (800) 245-7963 • Fax: (603) 742-5456
Hours: M-TH 8:30-6:00, Fri. 8:30-8:00, Sat. 8:30-5:30

Why Buy From Us?

NE's Largest Telescope Display

Mail-Order or In-Store. No Sales Tax!

Used Scopes — Buy, Sell or Trade-In

Knowledgeable, Helpful, Friendly Staff

TeleVue®

AUTHORIZED
CELESTRON®
DEALER
Nexstar Telescopes in stock

Rivers CAMERA SHOP
454 Central Ave.
Dover, NH 03820
www.riverscamera.com

Over 12,000 Product Descriptions Online!

Order Online @ **www.focuscamera.com**

TOLL FREE FAX
800-TO-FOCUS
OVERSEAS FAX
718-437-8811

4419-21 13TH AVE.
BROOKLYN, N.Y. 11219
888-221-0828

N.Y. STATE & OVERSEAS
718-437-8810
E-MAIL ADDRESS
orders@focuscamera.com

MEADE ADVANCED PRODUCTS

MAKSUTOV-CASSEGRAINS

ETX SCOPES

Exquisite, Diffraction-Limited Imaging in an advanced, ultra portable telescope system!

ETX-90EC Includes: w/Dual-Axis Drive, 8x21 Erect-Image Viewfinder & 26mm Plossl

ETX- 125EC Includes: Dual-Axis Drive, 8x25 Right-Angle Viewfinder & 26mm Plossl

Optional #497 Autostar controller with GO TO capability **$149**

NEW! **ETX 60 AT** 60mm (2.4"), 350mm f/5.8	$299
NEW! **ETX 70 AT** 70mm (2.8"), 350mm f/5	$349
ETX 90EC 1250mm f/13.8	$595
ETX 125EC 1900mm f/15	$895
LX-50 7" f/15 w/Std Equatorial Wedge	$1,795
LX-200 7" f/15 w/Heavy Duty Fork Mount	$2,795
#883 Deluxe ETX Field Tripod (90/125)	199.00
#64 Photo Adapter (90/125)	34.95
#825 8x25 Right-Angle Viewfinder (90)	49.95
#880 Equatorial Table Tripod (90)	29.95
#881 Equatorial Table Tripod (125)	59.95
#932 45° Erecting Prism (90/125)	49.95
#1244 Electric Focuser (90)	119.95
#1247 Electric Focuser (125)	119.95
#773, #774, #775 Hard Case for ETX	CALL

PICTOR CCD IMAGERS
416-XTE & 1616-XTE

With New Kodak Blue-sensitive CCD Chip

For the beginner, or for the most advanced observer, the real CCD revolution is here!

201-XT Autoguider/Imager	395
208-XT Autoguider/Imager	495
216-XT Autoguider/Imager	695
416-XTE Autoguider/Imager	1,995
1616-XTE Autoguider/Imager	6,495
Off Axis Guider f/CCD	89.95
616 Color Filter System f/416, 1616-XT	695
616A Color Filter System f/216	695
520 Electronic Relay f/201, 208, 216, 416, 1616	94.95
541 AC Adapter f/201, 208, 216	36.95
542 AC Adapter f/416, 1616	94.95

EYEPIECES

MODIFIED APOCHROMATIC

9, 12, 25, 40mm 1.25"	37.95	9, 12, 25, 40mm .96"	29.95

PLOSSL SERIES 3000

5, 6.7, 9.5, 16, 25mm 1.25"	49.95	40mm 1.25"	79.95

SUPER PLOSSL SERIES 4000

6.4, 9.7, 12.4, 15, 20, 26mm 1.25"			79.95
32, 40mm 1.25"	99.95	56mm 2"	199.95

PLOSSL SERIES 4000 SUPER WIDE ANGLE

13.8mm 1.25"	139.95	18mm 1.25"	149.95
24.5mm 1.25"	179.95	40mm 2"	299.95
32mm 2"	239.95		

PLOSSL SERIES 4000 ULTRA WIDE ANGLE

4.7mm 1.25"	169.95	8.8mm 1.25"/2"	239.95
6.7mm 1.25"	199.95	14mm 1.25"/2"	299.95

ILLUMINATED RETICLE EYEPIECE SYSTEMS

	Wireless	w/Cord
Plossl 9mm 1.25"	149.95	129.95
MA 12mm 1.25"	99.95	79.95
MA 12mm Astrometric 1.25"		119.95
Plossl 25mm CCD Framing Ocular 1.25"		129.95

BARLOWS

#122 2x Telenegative 1.25"	44.95
#126 2x Short Focus 1.25"	44.95
#127 2x-3x Variable 1.25"	56.95
#134 Achromatic .96"	44.95
#140 2x Apochromatic 1.25"	74.95

SCHMIDT-CASSEGRAINS

In virtually every country in the world where serious telescopes are sold, more Meade LX-200's are sold than all competing models combined.

Standard-equipment includes:
- Superb optics
- Automatic GO TO capability
- LX-200 High-Precision Pointing
- Permanently-Programmable Smart Drive
- 9-Speed Dual-Axis Electronics
- Field operation

NEW! **LX-90 8"** f/10	$1695
LX-10 8" w/Hand Controller	$995
LX-50 8" f/10	$1,395
LX-50 10" f/10	$1,695
LX-50 10" f/10 w/Super Wedge	$1,895
LXD 300 SERIES 203 8" f/10	$795
LXD 500 SERIES 203 8" f/10	$895
LX-200 8"	$2,295
LX-200 10"	$2,695
LX-200 12"	$3,995
LX-200 16"	CALL
LX-200SC 12" f/2.2 Schmidt-Camera	CALL
Magellan I #2014 f/LX-10	375
Magellan II #2024 f/LX-50	495

ED APO REFRACTORS

300 SERIES

102 Achromatic 4" f/9	$595

500 SERIES

102 Apochromatic 4" f/9	$1,649
102 Achromatic 4" f/9	$695
102ED 4" f/9 w/Mount, Tripod & Acc.	$2,795
127ED 5" f/9 w/Mount, Tripod & Acc.	$3,295
152ED 6" f/9 w/Mount, Tripod & Acc.	$4,995
178ED 7" f/9 w/Mount, Tripod & Acc.	$5,995
Optical Tube Only	CALL
#1207 Electric Focuser	144.95
#1664 Electronic Drive	349
#1697 Computer Drive System	749
#1702 Dual Axis Drive System	195
#1812 Electronic DC Adapter	89.95

ACCESSORIES

#62 T-Adapter f/SCT	26.95	Off Axis Guider	79.95
#931 45° Hybrid Erct Prsm	43	f/6.3 Focal Reducer	129.95
Basic Tele-Extender	29.95	**#1205** Focuser	CALL
Camera Adapter 1.25"	29.95	**#1206** Focuser	CALL
Camera Adapter .96"	27.95	6x30 Viewfinder	CALL
Variable Tele-Extender	39.95	8x50 Viewfinder	CALL
DEW SHIELD & DUST COVER	Call	**#607** 25' Cigarette Adpt	25
Piggyback Bracket f/SCT	Call	55 Manual DEC Control	75

Variable Projection Camera Adapter 1.25"	39.95
#927 45° Erect Image Diagonal Prism .96"	42.95
#928 45° Erect Image Diagonal Prism 1.25"	42.95
#929, #930 2" Mirror Diag. w/Eyepiece Holder f/1.25"	99.95
Tube Balance Weight System f/All SCT	CALL
#531 Motor Drive w/Auto Tracking f/4500 Newtonian	CALL
Interface Cable f/LX-200	25
EPOCH 2000sk Sky Software 3.5" Disks	149
EPOCH 2000sk Sky Software CD	179
EPOCH 2000ip Software 3.5" Disks	199

FILTERS

#905 Variable Polarizer 1.25"			49.95
Moon Filter ND96 1.25"	16.95	4 Piece Set 1.25"	49.95
Individual Filters	14.95	Skylight/Dust Seal	44.95

* Nebular	Oxygen III	Broadband*	Narroband*
#908 1.25"	99.95	79.95	89.95
#910 2"	159.95	119.95	129.95
#911 Rear Cell	149.95	99.95	119.95

STARFINDERS

Dobsonian Deluxe Package Add $49.95

SPECIAL EYEPIECE OFFER! At time you order any Meade Equatorial, get a 9.7mm Series 4000 Plossl **for only $29.95!**

	Dobsonian	Equatorial
6" f/8 w/26mm Plossl	$349.95	$649.95
8" f/6 w/26mm Plossl	$449.95	$749.95
10" f/4.5 w/26mm Plossl	$599.95	$879.95
12" f/4.8 w/26mm Plossl	$895.95	-
16" f/4.5 w/26mm Plossl	$1,195	$2,695

Magellan I #2010 f/Dobsonians	295
Magellan I #2011 f/Equatorial 6", 8", 10"	295
Magellan I #2012 f/Equatorial 16"	295
Magellan II #2018 f/Equatorial 6", 8", 10"	495
Magellan II #2019 f/Equatorial 16"	595

DIGITAL ELECTRONIC SERIES

The Most Important Advancement in Begining and Intermediate Telescopes in 100 Years!

- Object tracking
- Altazimuth mountings
- Electronic controller (EC)
- Autostar computer controller
- Meade StarNavigator software

ACHROMATIC REFRACTORS

DS-60 60mm (2.4"), 700mm f/11.8	$199
DS-70 70mm (2.8"), 700mm f/10	$249
DS-80EC 80mm (3.1"), 900mm f/11.3	$449
DS-90EC 90mm (3.5"), 1000mm f/11.1	$499

NEWTONIAN REFLECTORS

DS-114EC 114mm (4.5"), 910mm f/8	$399
DS-127EC 127mm (5"), 1020mm f/8	$499
Optional Autostar Controller	$99.95

SPECIALS!

Bausch & Lomb

2x Barlow 1.25" (#631016) $34.95

Harbormaster Telescope
- Individually Numbered
- Hand Finished Legs
- Brass Tube $1799.95

MEADE

2045s 4" Spotting Scope $409.95

CELESTRON

C90 Multi-Coated Spotting Scope (#81011) $289.95

BINOCULARS & SPOTTING SCOPES

CELESTRON

BLOWOUT!

8-32x50 Zoom $114.95

9x63 Ultima	CALL	20x80 Giant	368.95
8x32 Ultima	188.95	10x50 Regal	CALL
8x56 Ultima	268.95	8x40 Pro	114.95

MEADE

8x25 Safari Pro	180	10x25 Safari Pro	200
7x36 WA Safari Pro	170	8x42 WA Safari Pro	180
10x42 Safari Pro	190	10x50 WA Safari Pro	200
7x42 WA Rainforest Pro	480	8x56 Rainforest Pro	500

Nikon. SPORT OPTICS

You'll Never See Things Quite The Same Again!

7x35 E 245 8x30 E	257	10x70	1048.95
8x32 E Superior	CALL	7x50 Prostar	721.95
10x42 E Superior	CALL	10x40 Lookout IV	102.50
12x50 E Superior	CALL	10-22x50 Scoutmaster XL	135

SPOTTING SCOPES

Fieldscope (60mm)			347.95
Fieldscope 60 ED II	574.95	60 ED II Angled	634.95
Fieldscope 78 ED	1229.99	78 ED Angled	1299.99

Leica

SPOTTING SCOPES
APO TELEVID 77mm
Ask About Leica's Passport Protection

Kowa

77MM SERIES SPOTTING SCOPES

TSN-2	379.95	TSN-3	799.95

TSN-4 $649.95

82MM SERIES WATERPROOF SPOTTING SCOPES

TSN-821 Angled	CALL
TSN-822 Straight	364.95
TSN-823 Angled	814.95
TSN-824 Straight	CALL

Check Out Our Special Package Pricing on 820 Series Spotting scopes
Package includes: Scope, 20-60x, Case & Tripod.

ZEISS

Special! 15x60	$1,849
20x60 Image Stabilizer	CALL
Spotting Scopes	CALL

Canon

IMAGE STABILIZERS
10x30 • 12x36 • 15x45
15x50 AW • 18x50 AW
$50 Rebate!

FUJINON

SPECIAL! 7x50 FMTRC-SX w/Compass			499.95
8x30 FMT-RSX	CALL	10x70 FMT-SX w/Case	CALL
7x50 FMT-SX w/Case	CALL	16x70 FMT-SX w/Case	CALL
Super 80 Scopes w/Zoom & Case			CALL

C90 Multicoated Spotter Outfit

With Free T-Mount!

$299.95

#81013

CELESTRON

BAUSCH & LOMB BUSHNELL

SPOTTING SCOPES

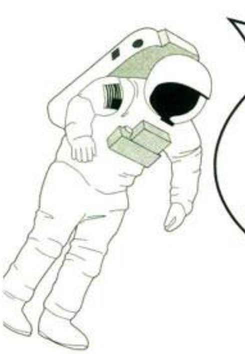
Discoverer 15-60x			176.95
Discoverer T-Mount	11.95	Camera Adapter	13.95
Spacemaster	149.95	Kit	247.95
Spacemaster Armored	163.95	Kit	259.95
Spacemaster Zoom Black Armored			226.95

All Kits Include: 15-45x Eyepiece & Case or Pouch

SWAROVSKI OPTIK

SPOTTING SCOPES
AT-80 • ST-80
AT-80 HD Angled
ST-80 HD Straight

Focus Camera, Inc., 4419-21 13th Ave., Brooklyn, NY 11219 ALL ORDERS ARE SUBJECT TO AVAILABILITY AND VERIFICATION. ORDERS ONLY CALL 888-221-0828 • INFORMATION & NY STATE CALL (718)437-8810 **Orders** ORDER STATUS & CUSTOMER SERVICE (718) 437-8899 • 24-HOUR FAX LINE (877) 863-6288 • STORE INQUIRIES (718) 436-6262. Shipped Promptly - Most Major Credit cards, Money orders & personal checks accepted for payment. COD orders are accepted but may require a deposit, personal checks may require up to 14 days to clear. All orders are subject to verification & acceptance. Shipping, handling & insurance are additional,please call/write for exact details. 14-day money-back guarantee (less shipping) provided merchandise is returned in new



America's
Largest Stocking
Authorized Astronomy
Dealer!

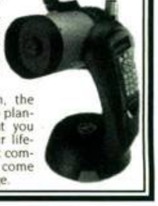
We Ship Promptly!

888-221-0828

N.Y. STATE & OVERSEAS
718-437-8810
E-MAIL ADDRESS
orders@focuscamera.com
Order on The Web at:
www.focuscamera.com

CELESTRON

SCHMIDT-CASSEGRAINS
NexStar 8



There is no substitute for size. With Celestron's legendary 8" optics, now you can see deeper into space with the same ease as with the innovative NexStar 5. Images in the NexStar 8 are over two times brighter than with a 5" telescope.

With the touch of a button, the NexStar 8 will open the door to planets, galaxies and nebulae that you have never experienced in your lifetime. Exquisite design, pinpoint computer control and stability come together in one dynamic package.

NexStar 8 8", 2032mm f/10	$1,899
NexStar 5 5", 1250mm f/10	$1,199
NexStar Tripod	$175
G-3 3.5", 1000mm f/11	$499
G-5 5", 1250mm f/10	$699
G-8 8", 2032mm f/10	$999
G 9 1/4 9 1/4", 2350mm f/10	$1,299
CM-1100 11", 2800mm f/10	$3,199

REFRACTORS

Firstscope 80 Series
80mm (3.1")
3 Models Avail.

Firstscope 70 Series
70mm (2.8")
3 Models Avail.

Firstscope 60 Series
60mm (2.4")
4 Models Avail.

Firstscope 60	$109
Firstscope 60 Equatorial	$159
Firstscope 80 Equatorial	$349
NEW! **NexStar 60 ST** 60mm (2.4")	$189
NEW! **NexStar 80 HC** 70mm (3.1")	$299
C80-HD 80mm (3.1"), 900mm f/11	$399
C102-AZ 102mm (4"), 1000mm f/10	$399
C102-HD 102mm (4"), 1000mm f/10	$499
CR-150-HD 150mm (6"), 1200mm f/8	NEW!

NEWTONIANS

NEW! **NexStar 114 HC** 114mm (4.5")	$399
NEW! **NexStar 114 GT** w/Go To	$499
Firstscope 76 Equatorial 76mm (3")	$159
C114-HD 114mm (4.5"), 900mm f/8	$399
C150-HD 150mm (6"), 1000mm f/7	$499

STAR HOPPER DOBSONIANS

4.5" ... $239 6" .... $399 8" $499

EYEPIECES & VIEWING ACCESSORIES

Diagonal, Prism Star	39.95	Diagonal, Mirror 2"	129.95
Diagonal, Erect Image 45°			39.95
Diagonal, Erect Image 90°			49.95
Plossl 1.25" 32, 40mm	49.95	Tele-Extender Dlx	48.95
Plossl 1.25" 6.3, 7.5, 10, 12.5, 17, 20, 26mm			39.95
Ultima 1.25" 5, 7.5, 12.5, 18mm			74.95
Ultima 1.25" 24, 30, 42mm			94.95
Ultima 1.25" 35			99.95
LV Series 1.25" 5, 6, 9, 10, 15mm			94.95
LV Series 1.25" 2.5, 4, 12, 20, 25mm			109.95
LV Series 1.25" 8-24mm Zoom			159.95
BARLOWS			
2x 1.25"	39.95	2x .96"	19.95
2x 1.25 Ultima	62.95	2x .96" Dlx	44.95

FILTERS

4 Piece Filter Sets	49.95	Skylight Filter	44.95
Moon Filter 1.25"	16.95	Solar Filters	CALL
LPR Filter Model A 1.25"			59.95
LPR Filter Model B f/Back Threads of SC's			84.95
Polarizing Filter Set 1.25"			42.95

SCHMIDT-CASSEGRAINS
CELESTAR 8 COMPUTERIZED

Engineered for unsurpassed optical performance in an affordable, full featured Schmidt-Cassergrain telescope of large enough aperture to do serious deep-sky observing. This telescope is carefully crafted and manufactured in the USA for dependable quality of the highest caliber. It offers the lowest price ever for a Celestron fork mounted 8" telescope.

CELESTAR 8 8", 2032mm f/10	$1,099
CELESTAR 8 Computerized	$1,599
CELESTAR 8 Deluxe	$1,699
CELESTAR 8 DLX Computerized	$2,199
ULTIMA 2000 8" 2032mm f/10 2032mm f/10 w/Go To System	$2,699
CM-1400 14", 3910mm f/11	$5,299

SPOTTING SCOPES
C5 Spotter

- Fully multicoated optics
- Excellent light gathering ability
- Standard 8x20 erect image finderscope
- Near focus of 20'
- 45° erect image diagonal & 26mm Plossl 48x eyepiece – both 1.25"
- 22mm eye relief and 1° field of view with standard eyepiece
- Fitted with convenient tripod adapter block

C5 Spotter	$599
80mm Wide View	$199
50mm Zoom	$99
60mm Zoom	$69
30mm Mini Spotter	$49

TRIPODS & MOUNTS

Heavy Duty Tripod (93499)	284.95
Photographic Tripod (93596)	99.95
Standard 8" Wedge (93656)	92.95
Heavy Duty Wedge (93655)	239.95
Upgrade Kit f/93655	109.95
Equatorial Mount CG-3	144.95
Equatorial Mount CG-5	369.95
CI-700 Mount	1,859.95
Vibration Supression Pads	39.95

ACCESSORIES

AC Adapter	18.95	Lens Shades	CALL
Focus Motor	114.95	Motor Drives	CALL
Car Battery Adapter	18.95	T-Adapter f/C90	28.50
Radial Guider	97.95	T-Adapter f/SCT's	24.95
Case f/C5 & C8 (Most Models)			209.95
Counterweight Bar Assembly 8"			89.95
Counterweight Bar Assembly 11"			94.95
DEC Motor f/C5+, Celestar 8, Ultima 9 1/4/11			CALL
Digital Setting Circles			299.95
Flashlight Red Astro Lite			9.95
Flashlight, Night Vision			21.95
Focus Micrometer, Digital			109.95
Hand Controller f/C5+, Celestar 8			49.95
Piggyback Mount 8"			34.95
Reducer/Corrector f/6.3			111.95

FINDERSCOPES

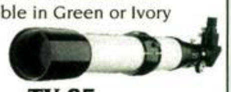
5x24	23.50	7x50 w/Illuminator	159.95
6x30	39.95	9x50	44.95

TeleVue
Visionary

Renaissance-101

101mm (4"), 540mm f/5.4
Available in Green or Ivory

IN STOCK!



TV-85

85mm, 600mm f/7
Available in Green or Ivory

IN STOCK!

Pronto™

70mm ED, 480mm f/6.8
Available in Ivory or Green

w/1.25" 45° Erect Prism (PGA/PIA)	$925
w/1.25" Star Diagonal (PGO/PIO)	$945
w/2" Star Diagonal (PGD/PID)	$1,085

Ranger

70mm ED, 480mm f/6.8
Available in Ivory, Green or Brass

w/1.25" 45° Erect Prism (RGA/RIA)	$685
w/1.25" Star Diagonal (RGO/RIO)	$695

Ranger Power Package
Includes: 90° Star Diagonal, 20-60x Zoom, 2.5x Powermate & Shoulder Bag (RPP2500) . $1,030

MOUNTS

TELE-POD MOUNT SYSTEM Complete 7lbs Mounting System Ideal for Traveling	$325
Ash Panoramic Mount	$455
Ash Gibraltar Mount	$530
Ash Gibraltar w/Sky Tour	$1,210
Up-Swing Head	$110

EYEPIECES

ZOOM EYEPICE 8mm-24mm $210

PLOSSL (50°)		**PANOPTIC (68°)**	
8, 11mm 1.25"	82	15mm 1.25"	210
15mm 1.25"	82	19mm 1.25"	240
20, 25mm 1.25"	95	22mm 2"/1.25"	280
32mm 1.25"	110	27mm 2"	330
40mm 1.25"	110	35mm 2"	365
55mm 2"	228	Barlow Interface	90
RADIAN (60°)		**NAGLER (82°)**	
3, 4mm 1.25"	228	4.8mm 1.25"	175
5, 6mm 1.25"	228	7mm 1.25"	220
8mm 1.25	228	9mm 2"/1.25"	240
10mm 1.25"	228	**NAGLER Type 2 (82°)**	
12mm 1.25"	228	16mm 2"/1.25"	310
14mm 1.25"	228	**NAGLER Type 4 (82°)**	
18mm 1.25"	228	12mm 2"/1.25"	340
NAGLER Type 5 (82°)		17mm 2"	370
31mm 2"	595	22mm 2"	445
BARLOWS			
2x 1.25"	105	2.5x Powermate	168
2x Big 2"	168	4x Powermate	265
3x 1.25"	105	5x Powermate	168

ACCESSORIES

RICH FIELD KIT Includes: 55mm Plossl, 2" Star Diagonal, SCT to 2" E.P. Adptr & 2" to 1.25" E.P. Adptr	410
RICH FIELD PREMIUM KIT w/Everbright 2" Star Diag.	480
Bino Vue Binocular Viewer	1,030
Paracorr Photo/Visual 2" Coma Corrector	235
NEW! *Everbright 2" Star Diagonal Mirror*	255
2" Enhanced Star Diagonal	190
1.25" Star Diagonal	75
1.25" Prism 45°	60
Air Chair	150
Basic Qwik Point (QPU)	19.95
Starbeam Projection Finder	180
Camera Adapter 1.25" & 2"	36
Piggy-Cam Camera Adapter	42

TELRAD

Finder Scope . . . $\$36^{49}$

ASTRONOMY BOOKS

The Deep Sky: An Introduction

By Philip S. Harrington Here is the perfect reference for anyone, who owns a telescope or a pair of binoculars but doesn't know what to look for amid the constellations. It explains how to find double and multiple stars, variable stars, open and gobular clusters, nebulae, and galaxies — what you'll see when you do.Includes 36 full-page sky charts; equipment, books, and software suggestions; sketches of how deep-sky objects look through a small telescope; and more than 100 black & white photographs. 272 pages.

The Deep Sky: An Introduction			24.95
Backyard Astronomer's Guide			39.95
Nightwatch: A Practical Guide to Viewing the Universe, 3rd Edition			29.95
Star-Hopping for Backyard Astronomers			19.95
Celestron Sky Map			16.95
Meade Star Chart			16.95
Sky Altas 2000			
Deluxe Edition			49.95
Desk Edition	27.95	Field Edition	27.95
Laminated Deluxe Edition			99.95
Laminated Desk Edition			59.95
Laminated Field Edition			59.95

JMI JIM'S MOBILE INC.

Next Generation Computers
Motofocus • NGF Focuser
Wheely Bars • Motodec

THOUSAND OAKS

Precision Glass Solar Filters
Mounted Type 2
Mounted Type 2 Plus
Mounted Type 3 Plus

ASTRONOMY SOFTWARE

RedShift 3
CD f/Windows . . . $\$44^{95}$
CD f/Macintosh . . $\$44^{95}$

The Sky
Level IV, Ver. 5
CD f/Windows .... $\$239^{95}$

Skymap Pro 6.0
CD f/Windows .... $\$89^{95}$

SkyChart III CD .... $\$38^{95}$

Take advantage of our *LARGE INVENTORY!* Immediate shipment from stock!

condition, unused as received with papers & packaging intact. We gladly accept and reply to written or faxed inquiries. Ad prices available while supplies last. This ad supersedes all previous ads. Focus camera is not responsible for typographical errors. Hours: Mon.-Thurs. 9-7, Fri. 9-2, Sun. 10-6.

LUMICON® High Performance

21 Years of Innovation!

WWW.LUMICON.COM

Visit our San Francisco Bay Area Showroom M-F 9-7, Sat 10-3

NexStar 8
CELESTRON

Two BIG items from the NexStar Family

First: The price of the NexStar 8 has DROPPED to $1,699. Second: Celestron has added 3 new beginner sized telescopes to the NexStar family

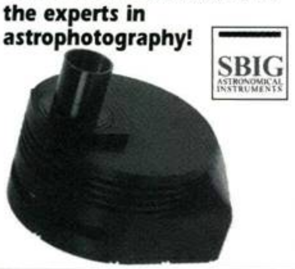
NexStar 60 GT 60mm f/12 refractor w Go-To Mount	$299
NexStar 80 GT 80mm f/5 refractor w Go-To Mount	$399
NexStar 114 GT 114mm f/9 Newtonian w Go-To Mount	$499
NEW! NexStar 4GT 4" f/13 Maksutov w Go-To Mount	$699

Other Celestron Telescopes at Lumicon

NexStar 5	$1199
Ultima 2000	$2699
Celestar Deluxe	$1699
Celestar	$1099
CM 1100– 11" SCT	$3199
Starhopper 8" Dob	$429
Starhopper 6" Dob	$339
C102-HD 4" Refractor	$549
FirstScope 114	$299
CR150 6" f/8 Refractor (REDUCED!)	$799

At Last!! Advanced Santa Barbara Instruments CCDs available thru Lumicon . . . the experts in astrophotography!

SBIG ASTRONOMICAL INSTRUMENTS



Lumicon is proud to announce that we are now an authorized dealer for quality Santa Barbara Instruments CCD cameras and accessories. Here is just a sample of what is available.

ST-237, Imager 640 x 480pixels	$1195
ST-5C, Imager 320 x 240 pixels	$895
ST-7E, Imager 765 x 510 pixels	$2950
NEW ST-10E, Imager 2184 x 1472 pixels	$7695
STV Video Camera Deluxe	$1995

Astrovid 2000, B&W Video Camera	$595
Astrovid Color Planet Cam	$495

LUMICON FILTERS - BEST IN THE WORLD BUT WHICH FILTER TO BUY?

LUMICON H-BETA
LUMICON UHC
LUMICON OIII
LUMICON DEEP-SKY

Lumicon Deep Sky Filters follow the classic broad band curve but offer the highest transmission of nebula lines of any such filter available. Lumicon Deep Sky filters block mercury and sodium vapor lamp emissions while letting thru all other parts of the spectrum. Deep Sky Filters are most useful for astrophotography (color & b&w) and CCD work. Deep Sky Filters are also useful visually, nebula offering the best contrast gain but galaxies, star clusters and dusty comets are also slightly enhanced.

1.25" Deep Sky Filter (fits most 1.25" eyepieces)	$99.50
48mm Deep Sky Filter (fits 2" eyepieces and Lumicon accessories)	$199.50
Visual Back Deep Sky Filter (fits in series on back threads of SCT'S)	$199.50
2" Deep Sky Filter (fits 2" eyepieces and T-threaded accessories)	$199.50
72mm Deep Sky Filter (for the front of large telephoto lenses*)	$399.50

*step rings for other sizes available.

Lumicon Ultra High Contrast Filters have a narrow band pass that lets thru the two oxygen III and the hydrogen beta lines while blocking the remaining visual spectrum. The resulting filter yields high contrast views of all types of nebula. It is best used visually with any telescope of f/6 or longer focal ratio. The Ultra High Contrast Filter is not for photography.

1.25" Ultra High Contrast Filter (fits most 1.25" eyepieces)	$99.50
48mm Ultra High Contrast Filter (fits 2" eyepieces and Lumicon accessories)	$199.50
Visual Back Ultra High Contrast Filter (fits in series on back threads of SCT'S)	$199.50

Lumicon Oxygen III filters isolate just the two oxygen III lines of the spectrum and block the remaining visual spectrum. The Oxygen III filter yields the maximum contrast gain possible on planetary nebula and most emission nebula. Views of the Veil Nebula and others with this filter are beyond words. The Lumicon Oxygen III Filter is for visual use only and is best suited for 6" and larger aperture telescopes with focal ratio of f/10 or faster.

1.25" Oxygen III Filter (fits most 1.25" eyepieces)	$99.50
48mm Oxygen III Filter (fits 2" eyepieces and Lumicon accessories)	$199.50
Visual Back Oxygen III Filter (fits in series on back threads of SCT'S)	$199.50

Lumicon Hydrogen Beta Filters isolate just the hydrogen beta line of the spectrum and block the remaining visual spectrum. The Hydrogen Beta filter was created with a select number of low energy nebula in mind such as the Horsehead, Cocoon & the California nebula. In many instances the Hydrogen Beta filter is the **ONLY** way to see these nebula. The Hydrogen Beta Filter is a visual filter only, best suited to 8" or larger aperture telescopes with focal ratios of f/5 or faster.

1.25" Hydrogen Beta Filter (fits most 1.25" eyepieces)	$99.50
48mm Hydrogen Beta Filter (fits 2" eyepieces and Lumicon accessories)	$199.50
Visual Back Hydrogen Beta Filter (fits in series on back threads of SCT'S)	$199.50

Special Pricing – Buy two or more Lumicon filters and get a DISCOUNT.

Filters normally priced at $99.50	pay only $92.50
Filters normally priced at $199.50	pay only $185.00

SKY VECTOR™ $349!!!

Includes Computer, Encoders, Hardware

LUMICON Sky Vector Features:

- "GUIDE" mode leads you to object
- Digital right ascension readout to 1 min.
- Digital declination reading to 10 arc/min.
- 4000 pulse (0.09 accuracy) encoders
- Polar Alignment NOT REQUIRED!
- Motor drive NOT REQUIRED!
- Just two stars to align
- Works Equally well for alt-azimuth telescopes like Coulter Odyssey and equatorial mounts like C-8, Meade 2080.
- No need to enter latitude, longitude etc.

SKY VECTOR I™ $349.00

NEW! With over 220 object memory including the 110 Messier and 58 best NGC objects.

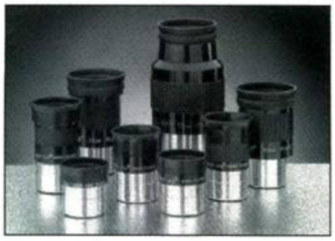
NGC-SKY VECTOR™ $489.00

12,000 objects! PC serial port NGC Sky Vector with IDENTIFY (Sky Tour) mode; 12,000 object memory including the corrected RNGC catalogue, IC catalogue, P&K planetary catalogue and much more.

NGC-Sky Vector
OFF ON
MODE
ENTER
UP
DOWN
LUMICON

Specify Telescope Type: Meade 4",8", 10",12" SCT, C-8, C-11, Odyssey 8", 10", 12", 17$^{1/2}$" alt-azimuth; Meade 6"-16" Dobsonian. Ultima 8", 9 $^{1/4}$", 11" add $25.
C-14 add $75.

TELE VUE PRODUCTS



4X Powermate for 2" eyepieces	$265
5X Powermate boosts magnification 5x	$168
Ranger 70mm f6.8 apchromat w/1$^{1/4}$" diag.	$695
Pronto 70mm f6.8 w/1$^{1/4}$" diagonal.	$945
Tele Vue 85,85mm f/7 APO telescope	$1995
Bino Vue binocular w/2x correc.	$1030
Gibraltar mount with ash wood tripod	$530
8,11,15mm Plossl . $82 — **20,25mm**	$95
32mm Plossl, widest true field in 1$^{1/4}$"	$110
55mm Plossl, widest possible field	$230
2.0x or 3.0x Tele Vue Barlow Lens	$105
2" Giant Barlow – 2x	$168
4.8mm Nagler 82° field, 1 1/4 " eyepiece	$175
7mm Nagler, 1$^{1/4}$ " eyepiece, 82° field	$220
9mm Nagler, 82° field 1$^{1/4}$ " or 2"	$240
12mm Nagler Type 4, 82° 1 1/4 "or 2"	$340
16mm Nagler Type II, 82° 1 1/4 "or 2"	$310
17mm Nagler Type 4, 82° 2" only	$370
22mm Nagler Type 4, 82° 2" only	$445
31mm Nagler Type 5, 82° 2" only	$595
2" Paracorr tunable coma corrector	$280
3,4,6,8,10,14mm Radian,60° field	$228
18mm Radian,60° field	$228.
15mm Panoptic 1$^{1/4}$", 68° field	$210
19mm Panoptic 1$^{1/4}$", 68° field	$240
22mm Panoptic 1$^{1/4}$"/2", 68° field	$280
27mm Panoptic 2", 68° field	$330
35mm Panoptic 2", 68° field	$365

Note: Tele Vue warranty may not be valid outside USA

Tele Vue's Newest!

Lumicon, always in the forefront bringing you the latest scopes and specials, brings you the newest scope from Tele Vue. The Tele Vue 102 (shown with optional Gibralter Mount) brings you the best of apochromatic optics in a longer 880mm f/8.6 length making it and even better choice for planetary viewing than previous releases.

Tele Vue 102 tube assembly only	$2050
Tele Vue tube holder for 102	$120
Tele Vue Ash Gibralter Mount	$530
Lumicon 2" Enhanced Aluminum Star Diagonal	$189.50
Lumicon 2"/1.25" Reducer	$25

We are Takahashi dealers
Call for lowest prices!

LUMICON

6242 Preston Avenue, Livermore, CA 94550

Phone Orders: Call our toll free ORDER LINE: 1-800-767-9576
EXPERT Information and Catalog Requests: Call 1-925-447-9570
FAX 1-925-447-9589 ▪ Prices subject to change without notice
In stock items shipped within 2 business days

LUMICON®

6242 Preston Avenue
Livermore CA 94550

Phone hours: M-F 9AM/7PM pst
Sat. 10AM/3PM pst 1-925-447-9570

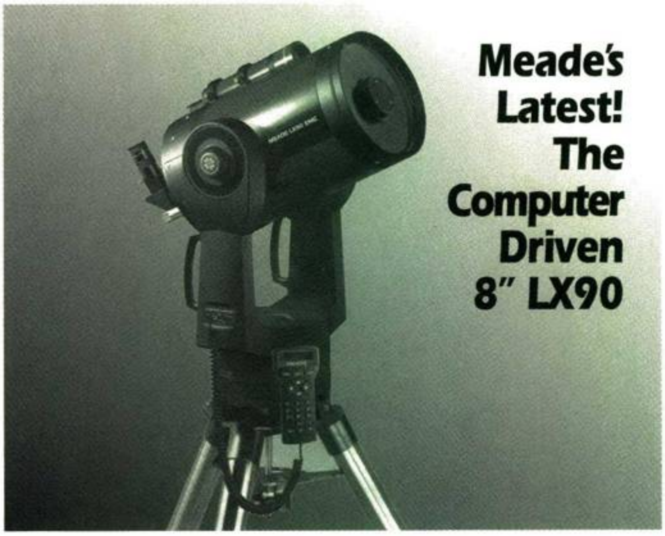
Telescopes and Accessories

ORDER TOLL FREE
1-800-767-9576

Lumicon H-Alpha Pass Filter

The Lumicon H-Alpha Pass Filter is a powerful light pollution filter for astrophotography near city lights. The light curve of the H-Alpha Pass Filter is ideal for use with Hypered Tech Pan film or with CCD Cameras for the highest contrast and sharpest detail. (NOT for Solar viewing!) Comes in three sizes with step rings to most other sizes available.

48mm H-Alpha Pass Filter	$59
58mm H-Alpha Pass Filter	$69
77mm H-Alpha Pass Filter	$79



Meade's Latest! The Computer Driven 8" LX90

PENTAX EYEPIECES

Great Prices! Pentax 65°XL

Amazing performance! All have 20mm eye relief, adjustable helical eye guard, super multi-coatings, E.D. Glass

5.2mmF.L., 65°Apparent Field 1¼"	$279
7mm F.L., 65° Apparent Field 1¼"	$279
10.5mmF.L., 65°Apparent Field 1¼"	$269
14mm F.L., 65° Apparent Field 1¼"	$269
21mmF.L., 65°Apparent Field 1¼"	$269
28mm F.L., 55° Apparent Field 1¼"	$259
40mmF.L., 65°Apparent Field 2"	$299

Pentax Binoculars Spectacular 20mm eye relief:

5x40mm Pentax PCFV Binocular	$169
7x50mm Pentax PCFV Binocular	$169
10x50mm Pentax PCFV Binocular	$184
16x60mm Pentax PCFV Binocular	$249

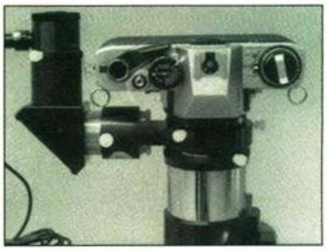
THE SCOPE REVOLUTION CONTINUES

Meade engineers have come out with their latest entry in the computer driven telescope revolution. The 8" LX90 combines Meade's proven optics with a dual metal fork arm mount and Autostar technology to produce a low priced, fully capable alternative. Both axis have a 4.9" worm drive for smooth motion. The 8" LX90 comes with the same tripod as the LX200. **All for a low $1695** (plus $95 shipping)

Other Fine Meade Telescopes at Lumicon

8"LX200 SCT with Tripod ($105p/s)	$2295
10"LX200 SCT with Tripod ($145p/s)	$2695
12"LX200 SCT with Tripod ($215p/s)	$3995
Wedge for 8" LX200(for photog) ($15p/s)	$139
Superwedge for 10"/12"LX200($35p/s)	$395
8" LXD500w/German eq. mt ($65 p/s)	$895
8"LX10 SCT w/RA drive ($65 p/s)	$995
ETX 90EC Maksutov w/std.drives ($20p/s)	$595
ETX125EC Maksutov w/std.drives ($30p/s)	$895
DS80 EC w/dual drives ($45p/s)	$449
DS90 EC w/dual drives ($50 p/s)	$499
DS114EC w/dual drives ($45 p/s)	$399
DS127ED w/dual drives ($50 p/s)	$499

3 Choices of our Lumicon Easy Guiders ™



Newtonian Easy-Guider ™

The **LUMICON NEWTONIAN EASY-GUIDER ™** is the best choice on the market for guiding both Newtonian and Refractor telescopes. Off-axis guiding is the surest way to get pin-point star images. The two-way adjustment on the off-axis tube avoids the problems of finding and centering a guide star in your eyepiece or autoguider. A 35mm camera adapter is included (specify camera). Available for either 1.25" or 2" focusers at

$189.50 each

Cassegrain Easy Guider™

For 8" Schmidtt-Cassegrain telescopes choose the **LUMICON CASSEGRAIN EASY GUIDER™.** Includes mutiple adjustments for easily finding and centering a guide star and for composing the picture. The included internal 50mm focal reducing lens delivers brighter f/6 photographic images and can be used visually with an optional adapter. The lens can be removed for f/10 photography. A 35mm camera adapter (specify camera) is included.... **$249**

Visual Adapter ... **$25**

Lumicon Giant Easy Guider™

The king of off axis guiders is the **LUMICON GIANT EASY GUIDER™.** Made for Schmidtt-Cassegrain telescopes of 10" through 16" diameter, the giant easy guider attaches to the large 3" rear threads of these scopes. Included is an 80mm diameter focal reducing lens capable of delivering f/7 to f/4 photographic speed. Replacing the included 35mm camera adapter (specify camera) with a 2" star diagonal turns the giant easy guider into a full aperture rich-field viewer... **$395**

1¼" viewing adapter for rich-field.. **$25**

Additional Lines Sold by Lumicon

- Celestron
- Meade
- Tele Vue
- Losmandy
- JMI
- JMB Solar Filters
- Beattie Intenscreens
- Fujinon Binoculars
- Kendrick
- Telrad
- Rigel
- Pentax
- Tectron

Prices are constantly changing on many items. Call Lumicon's toll free number to get the latest, lowest quotation on these items and more.

Want to see Lumicon products first hand? Visit these fine Lumicon retailers. They will be happy to explain the benefits of Lumicon accessories.

Scope City
Call (805) 522-6646
for the store
nearest you

Astronomics
680 S.W. 24th Avenue
Norman, OK 73069
(800) 422-7876

Pocono Mountain Optic
104 NP 502 Plaza
Moscow, PA 18444
(800) 569-4323

DISCOVERING WORLDS IN TRANSIT

Astronomers are finally on the cusp of finding planets like ours.

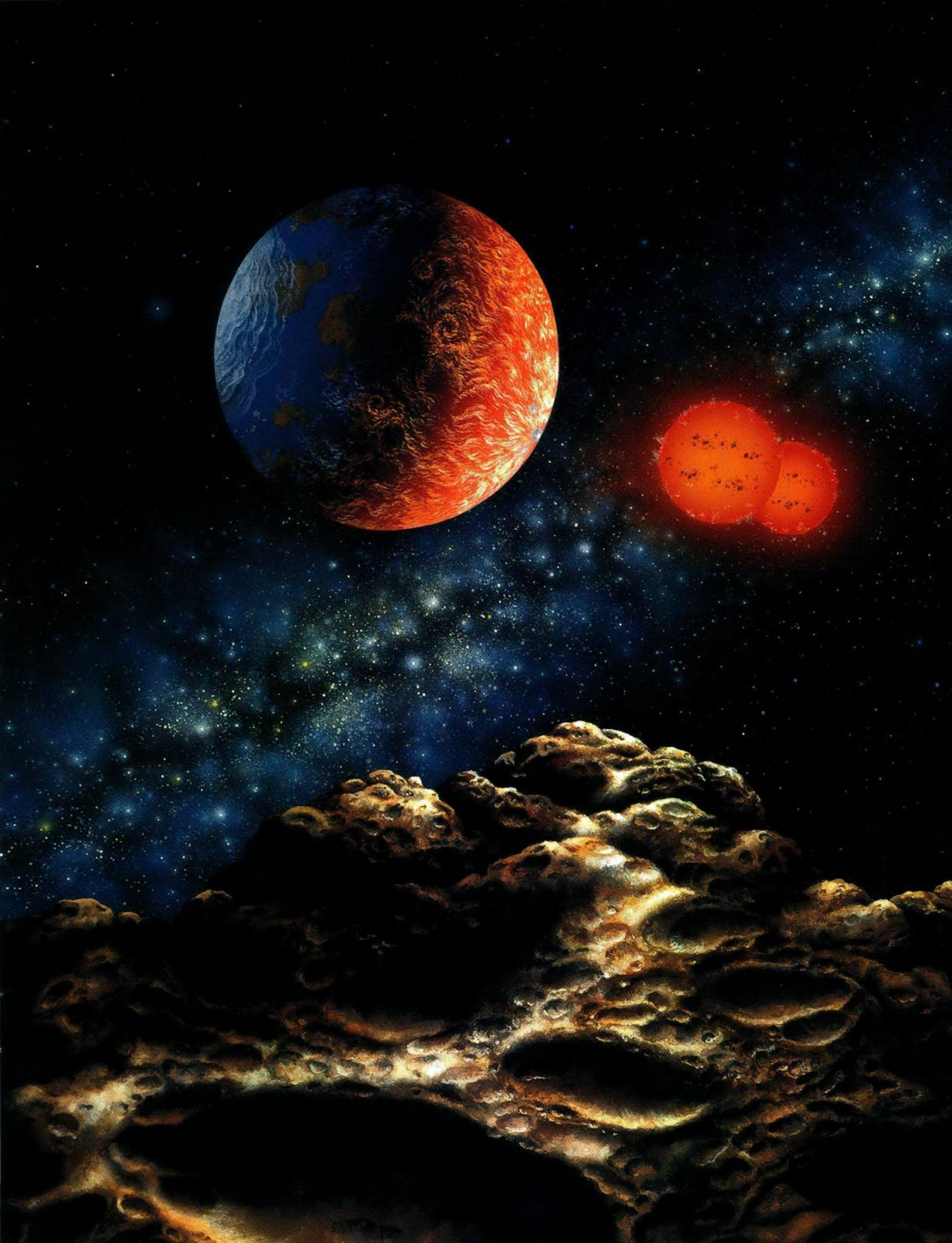
by Laurance R. Doyle, Hans-Jörg Deeg, and Jon M. Jenkins

Stop for a moment and ponder the possible existence of other worlds like Earth. If they really do exist, it's only a matter of time — observing time — before we find them. The race is on and the stakes are high.

As an extrasolar planet hunter, you can't afford to be timid or meek; you've got to be willing to stick your neck out. What's more, to stay on top of the game, planet hunters must employ the most robust search methods currently available on the astronomical market.

While the standard workhorse method for detecting extrasolar planets — through the Doppler signature, or wobble, produced on the spectra of the stars they orbit — has enjoyed unparalleled success, it is approaching its limits. Even with the best detectors and largest telescopes in the world, Earth-sized planets — the Holy Grail of the planet-hunting universe — continue to elude those who employ this "radial velocity" technique.

Is the universe teeming with life-sustaining, terrestrial planets? Astronomers think eclipsing binary systems, such as CM Draconis, may be the best place to begin the search. Lynette R. Cook



To find those elusive, Earth-like worlds, astronomers must adopt novel and clever detection methods, which compliment the mass divining capabilities of the radial velocity method yet possess the sensitivity necessary to record the subtle orbital and optical effects of an Earth-like planet. This is the story of how one extrasolar planet hunting technique — called the Photometric Transit Method (PTM) — is showing significant promise in the ongoing search for distant, Earth-like worlds.

We are a group of astronomers, working at various observatories around the world, who have conspired to continuously search for potentially habitable — a term generally reserved for planets with an ability to maintain surface water — Earth-like planets. Now, thanks to the dubious alliance of a giant planet orbiting the star HD 209458 and a little binary star system called CM Draconis, we're well on our way to finding just what we've been looking for. Our work represents the first modest search for potentially habitable planets outside the solar system in the region of the CM Draconis binary.

HD209458: A GLIMMER OF HOPE

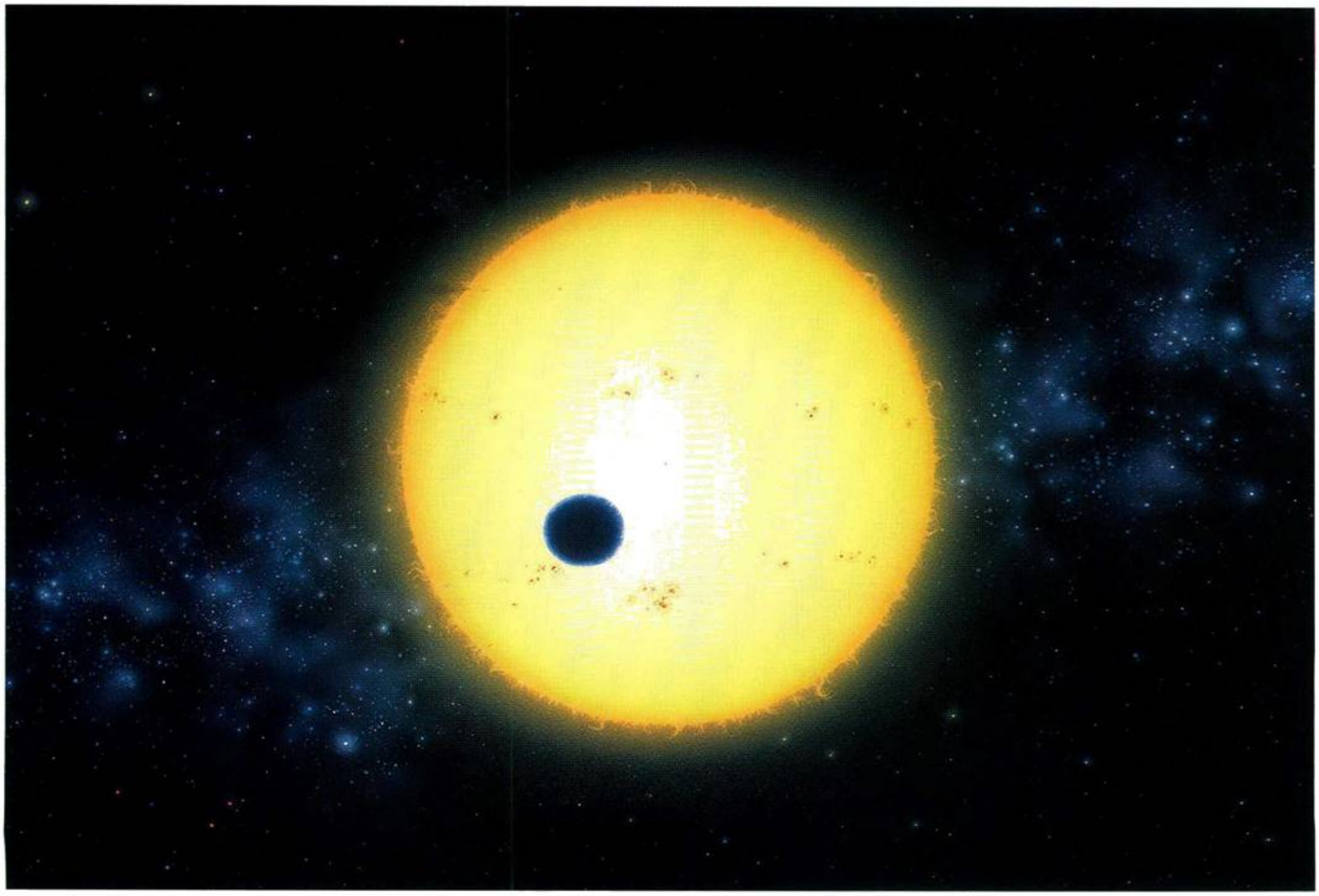
On November 7, 1999, HD 209458 dimmed slightly and subsequently rebounded to full brightness over the course of a few hours. Analysis from the November observation, as well as subsequent observations of HD 209458, confirmed that astronomers witnessed, for the first time outside of the solar system, the direct effects of a planet crossing the face of a star — an event known as a planetary transit.

As it turns out, two independent teams of astronomers had suspected, from earlier Doppler measurements, that a Jupiter-sized planet was orbiting HD 209458 at a distance one-twentieth the separation between Earth and the sun. And because the planetary companion to HD 209458 was so close to its parent star, the likelihood that it might actually pass right in front of HD 209458 was rather high — about 10 percent. In general, it is quite unlikely that an extrasolar planet's orbit will be favorably aligned to produce regular transit events. For example, the average extraterrestrial astronomer only has about a one percent chance of seeing Earth transit our sun.

Size Matters: Why CM Draconis?

The likelihood that a planet will have an edge-on orbit, so as to cross our line-of-sight, depends mostly on the distance of the planet from its star, but also somewhat on the size of the star as well. The closer the planet is, the larger its angular size relative to its parent star. In addition, the smaller the parent star is, the smaller the planet that may be detected through the Photometric Transit Method (PTM). That's because a planet of a given size will block a proportionately larger part of a small star's disk versus a large star's disk, making it easier for instruments to detect the brightness changes from a small parent star.

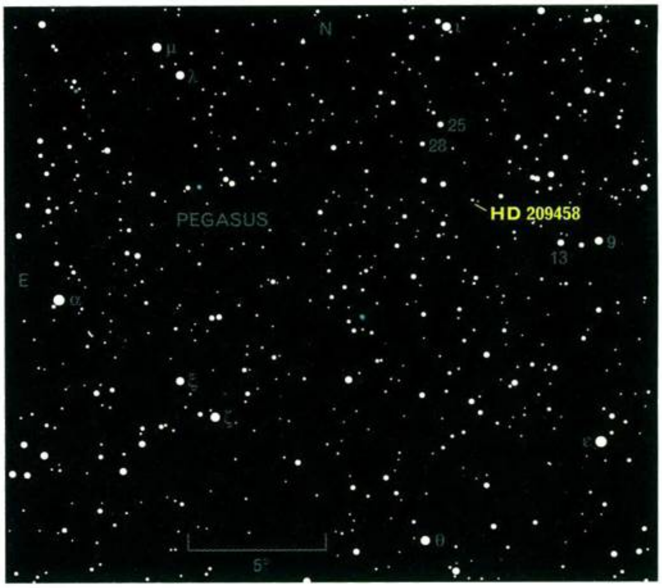
The eyes of an artist bring a transit of HD 209458 into focus. Mercury and Venus regularly afford Earthlings such awesome views. Lynette R. Cook



Find an Extrasolar Planet

If you have a small telescope equipped with a CCD camera, a photoelectric photometer, or even a stand alone CCD camera, you can detect the transit of a giant planet across the star HD 209458 (visual magnitude 7.65, right ascension 22h03m10.77s, declination 18°53'03.5"). You'll need a camera that can discern a 2-percent drop in the relative brightness of this star compared to nearby stars in the field of view (you may have to measure the brightness of several nearby stars and add them up before you compare them with the brightness of HD 209458).

See the mid-transit ephemeris table on page 43. Transits will start about 1½ hours before, and end about 1½ hours after, these times. Times are given in Universal Time (UT) for transit events that occur 30° or more above the local horizon (mean U.S. latitudes and mean latitude for southern Europe). Subtract 7 hours for Pacific Daylight Time (PDT), 4 hours for Eastern Daylight Time (EDT), add 1 hour for Central Europe Time (CET), and add 9 hours for Japan Standard Time (JST). Remember that this time correction may place the observation on the preceding day (i.e., before midnight) for U.S. observers.



Since the planet orbiting HD 209458 was observed to cross almost directly in front of the star's disk, its orbit must be very close to edge-on — perpendicular to the plane of the sky seen from our vantage point on Earth. Such an orbital configuration is valuable to astronomers because it allows them to place tight constraints on the parameters of the system. In fact, from that single event, which dimmed the light of HD 209458 by a paltry 1.8 percent, astronomers were able to determine the size (about one third larger than Jupiter), the mass (about two thirds the mass of Jupiter), and the density (one third the density of liquid water, something like that of a sponge cake) of the giant planet (see "Planet Caught Crossing Face of Distant Star," AstroNews, February 2000). Previously, astronomers were only able to determine simple orbital parameters and place a lower limit on the mass of the planet.

Due to the decreasing cost and increasing availability of Charge Coupled Device (CCD) cameras, the photometric transit method also enables amateur astronomers to detect extrasolar planets around nearby bright stars. The drop in brightness caused by giant planets — such as the one around HD 209458 — can be as much as 2 percent, well within reach of a CCD camera on a small telescope under a fairly dark sky. With a modest investment, amateur astronomers can hone their planet-searching techniques on HD 209458 (see "Find an Extrasolar Planet," pages 41, 43).

The 1999 transit observations of HD 209458 confirmed the existence of a suspected extrasolar planet. But what about discovering new planets through stellar transit events?

IMPROVING THE ODDS

There are several things that astronomers can do to increase their chances for actually discovering planets through transit events. First, one can observe a very large number of stars with the hope that at least a few will display transits. Simply due to chance, at least a few percent of extrasolar planets should have edge-on orbits. Indeed, several proposed space missions, such as the Kepler mission (led by William Borucki of NASA's Ames Research Center) and the European COROT mission, as well as a number of ground-based programs, are taking this wait-and-see approach.

Furthermore, one may exclusively observe star systems where a planet's orbit is almost sure to be edge-on, as Jean Schneider and Michel Chevreton of the Observatoire de Meudon in Paris first suggested. For example, planets orbiting double star systems called eclipsing binary systems are likely to have edge-on orbits. That's because planets circling both components of a double star system should be flattened down into the orbital plane of the companion stars. Moreover, modern computer simulations indicate that planets can exist in stable orbits around close double stars, as long as the planets are at least three times farther away from the stars as the stars are separated from each other.

Eclipsing binary star systems, of which thousands are known (such as CM Draconis), are fundamentally important to astronomy, as almost all direct stellar diameter and stellar mass measurements have been gleaned from observations of such systems. In these systems, the companion stars orbit a common center of mass in an edge-on orbit, so that they regularly eclipse each other. Two eclipses occur every orbital period as each star, in turn, passes in front of the other.

WAITING FOR THE DOUBLE DIP

A planet orbiting in the plane of an eclipsing binary will usually transit the system twice with each orbit. In truth, one or several transits may occur with each orbit, depending upon how frequently the stars orbit each other. Astronomers searching these systems for transits often look for a characteristic double dip, as the planet crosses one star and then the other. Moreover, as the planet transits the system, the two stars rapidly orbit each other. This causes the transits to occur much more quickly (less than an hour in duration each) than if the planet were moving across a single star. For example, an extraterrestrial astronomer would see that it takes Earth more than half a day to transit the sun.

Another observing advantage is that stars in close eclipsing binary systems are tidally locked in rotation. In other words, the two stars always face toward each other, similar to the way the moon always shows the same face toward Earth. This means astronomers won't mistake dark starspots on the stellar surfaces for planetary transits, because the starspots will appear and disappear with the known orbital period of the two stars.

Transit events around eclipsing binaries are termed "quasi-periodic" — they occur at predictable but irregular time intervals. Thus these planetary systems should exhibit regular stellar eclipses along with the much smaller semi-regularly recurring transits that can be matched to a planetary orbital period.

CM DRACONIS: A CASE FOR EARTH-LIKE WORLDS

To further maximize the chances for success, our research collaboration (called the TEP [Transit of Extrasolar Planets] Network) selected CM Draconis, one of the smallest known eclipsing systems, to lead the search for potentially habitable planets in eclipsing binary systems. Two red dwarf stars (spectral class M4), which orbit each other every 1.26 days, make up the CM Draconis binary. As each star is only about one-quarter the diameter of the sun, the stars' combined area only accounts for about 12 percent of the sun's disk area. This combination makes the CM Draconis system an ideal location to begin our search because transiting planets are easier to detect around small stars than large stars (see "Size Matters," page 40). In fact, an Earth-sized planet would produce a brightness drop in the bantam CM Draconis system that is about 8.3 times larger than if the same planet were to cross the face of the sun.

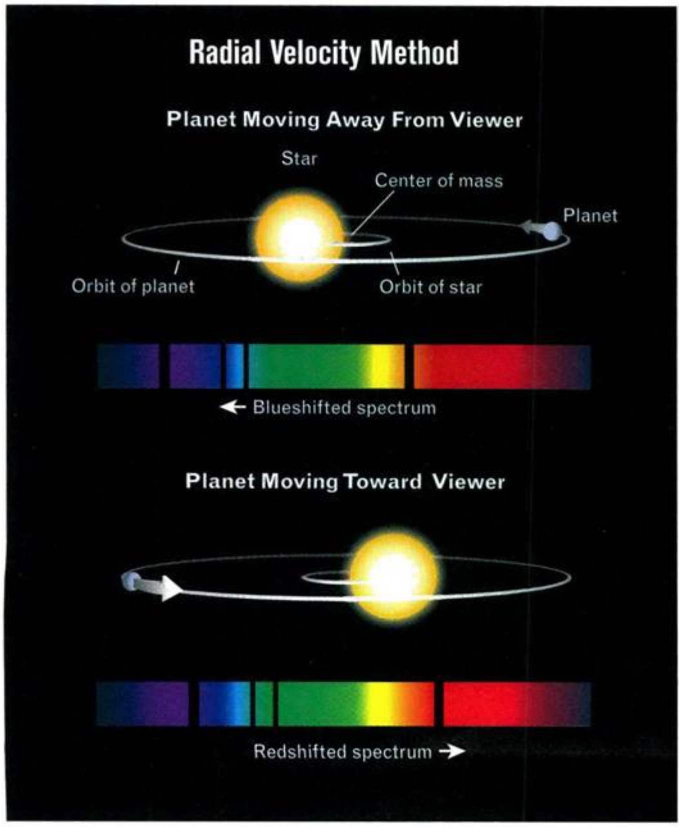
Members of the TEP Network observed CM Draconis for more than 1,000 hours from New York, New Mexico, California, South Korea, Russia, Greece, France, and the Canary Islands, between 1994 and 1999. And this year we plan to complete follow-up observations on two possible planetary candidates (with orbital periods of 20 and 26 days). Our analysis of the data shows that if any of these small dips in the brightness of the CM Draconis system are actually caused by a transiting planet, then the planet must be quite small — only 2.4 Earth-diameters in size. Indeed, this is much smaller than any of the nearly 50 giant, extrasolar planets so far discovered.

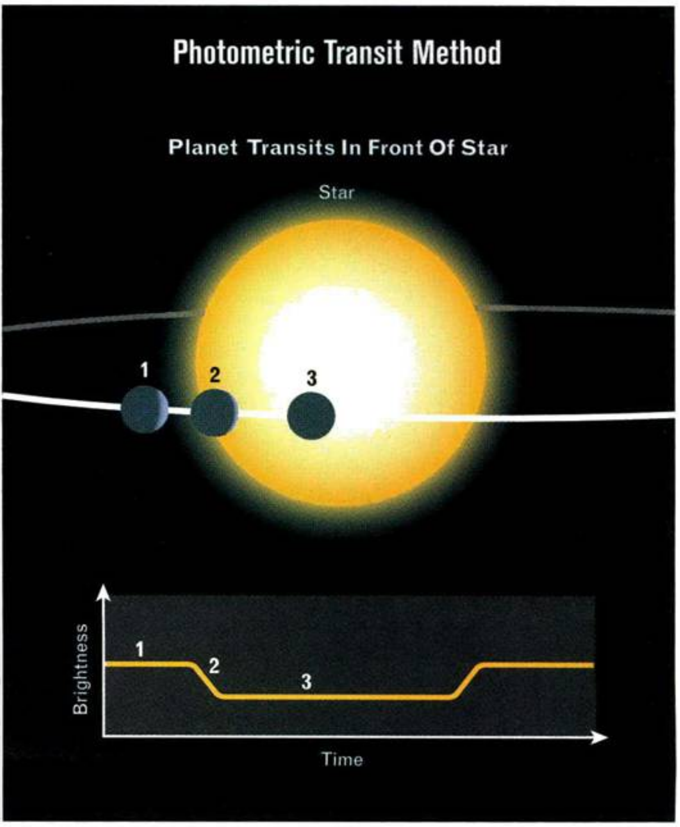
Because the two stars of the CM Draconis system (named A and B) are so dim (about 1.03 percent the brightness of the sun), any planets around these stars with orbital periods from 18 to 35 days would receive about as much light from both stars as the region between Earth and Mars receives from the sun. Thus, by current definitions of habitability, any candidate planets in this region could be small enough and at the right distances to be potentially habitable.

There may also be a giant planet circling the CM Draconis system. Nonetheless, timing variations from several dozen eclipse measurements show that there cannot be any planets much more massive than 3 times Jupiter's mass with orbital periods less than 4 years.

CHECKING ALL POSSIBILITIES

To calculate unambiguous brightness changes in the CM Draconis system, we took CCD exposures of CM Draconis as well as several nearby stars that don't vary in luminosity. We call these stars "standard stars." Although all the stars in an image will vary in brightness due to fluctuations in Earth's atmosphere, they should all vary in about the same way within a given image. By comparing the brightness of the standard stars with that of CM Draconis, we were able to quantify its brightness change relative to the standard stars.





Find an Extrasolar Planet

Transits of Planet HD 209458-b in 2001

Region	U.S. West	U.S. East	Europe	Japan
Longitude	120° W	80° W	0° W	135° E
Latitude	40° N	40° N	45° N	35° N
Obs. Window (UT)	3 – 13	0.5 – 10.5	19 – 5	10 – 20

Mo.	Day	Hr.	Min.	Sec.	Alt.	Alt.	Alt.	Alt.
6	22	9	44	0	54	68	–	–
6	29	10	55	15	67	–	–	–
7	6	12	6	30	65	–	–	–
7	10	0	42	7	–	–	53	–
7	17	1	53	22	–	–	63	–
7	20	14	29	0	–	–	–	51
7	24	3	4	37	–	–	60	–
7	27	15	40	15	–	–	–	69
7	31	4	15	52	–	51	47	–
8	3	16	51	30	–	–	–	72
8	7	5	27	7	–	66	–	–
8	10	18	2	45	–	–	–	56
8	14	6	38	23	58	67	–	–
8	21	7	49	38	69	52	–	–
8	28	9	0	53	62	–	–	–
8	31	21	36	30	–	–	56	–
9	4	10	12	8	45	–	–	–
9	7	22	47	45	–	–	64	–
9	11	11	23	23	–	–	–	56
9	14	23	59	0	–	–	58	–
9	18	12	34	38	–	–	–	72
9	22	1	10	15	–	55	–	–
9	25	13	45	53	–	–	–	69
9	29	2	21	31	–	68	–	–
10	2	14	57	8	–	–	–	51
10	6	3	32	46	61	64	–	–
10	13	4	44	1	69	48	–	–
10	20	5	55	16	59	–	–	–
10	30	19	42	8	–	–	64	–
11	6	20	53	23	–	–	55	–
11	17	10	40	16	–	–	–	66
11	24	11	51	31	–	–	–	47

The table shows mid-transit times for HD209458-b for all transits observable (i.e., above 45° in altitude) during 2001. Transits will begin 92 minutes before and after this time. The given altitude measurements are for either the United States, Europe, or Japan during mid-transit. HD209458 is at right ascension 22h03m10.77s and declination 18°53'03.5"

Of course, the best transit events to observe occur during moonless nights, at the highest altitude, and during the middle of the night. All times and dates are given in Universal Time (UT).

One way to tell if a drop in brightness is due to a real planetary transit or something else — like flickering due to turbulence in Earth's atmosphere — is to see if the times of the transits are consistent with the orbital parameters of a potential planet. Nonetheless, many possible planet orbits could produce transit features. Which of those fit the drops in the light curve at the right locations? To answer this question we had to test over 400 million planet models with various orbital periods as well as locations in their orbits (called the orbital phase) to find those that matched the observed drops in the CM Draconis system.

AND THE WINNERS ARE . . .

Our algorithm picked out nine possible planets that could account for the brightness dips in CM Draconis. Some would produce more dips than others — the number of dips in brightness (i.e., suspected transit events) ranged from 5 to 11, depending on the planet model. But all the dips were quite small, indicating that only planets smaller than about 2.5 Earth-radii could be present. A transiting planet as large as 3 Earth-radii would have required only one transit to be noticed by our algorithm. Still, these nine candidates needed observational confirmation before declaring them full-fledged planets.

So, we went back to the observatory hoping that the brightness of CM Draconis would drop again at the exact times predicted by the models. This was the only sure way to confirm or rule out the nine remaining planetary candidates. In 1999, we observed CM Draconis at a number of predicted transit times for seven of these nine candidate planets.

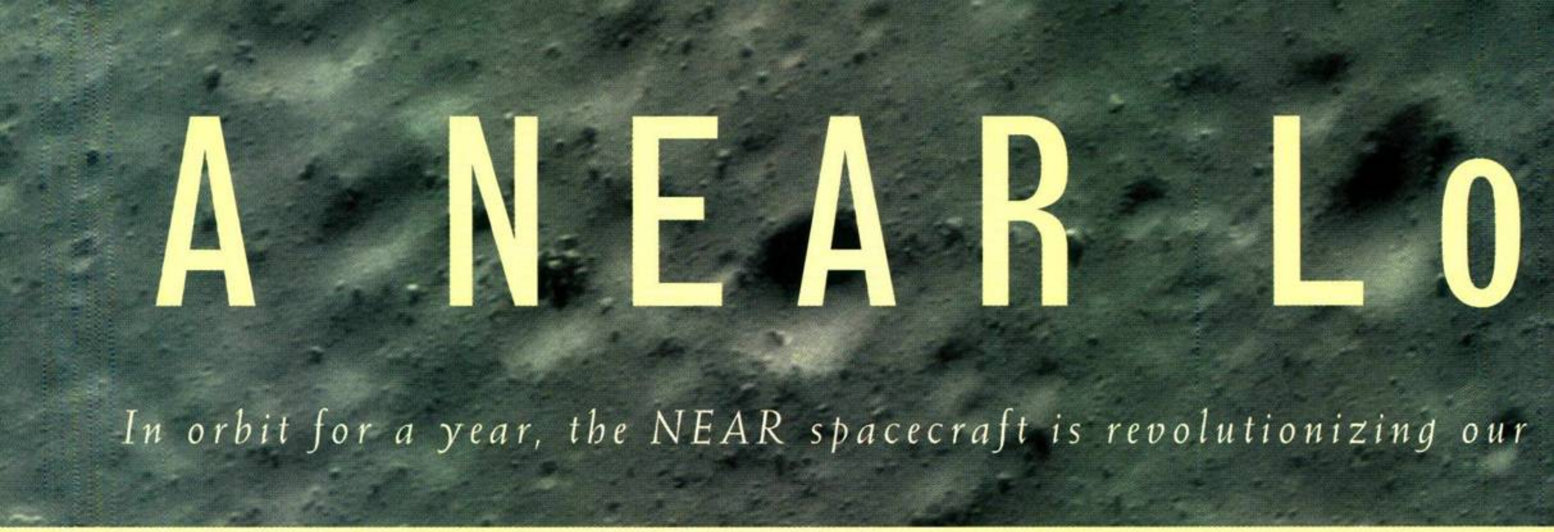
After searching for hundreds of millions of possible transiting planets with periods from 7 to 60 days, we've narrowed the field to two planetary candidates circling CM Draconis. It's exciting that both candidates (if they prove to be planets) lie within the habitable zone of the CM Draconis system. Moreover, the candidates are small enough to be large terrestrial planets (although their densities will remain unknown until their masses are measured). And by the middle of this year we will likely know if either of these candidates is our long-sought, Earth-like cousin.

The photometric transit method currently shows the most promise for discovering Earth-size, extrasolar planets. Within the next decade, several spacecraft and many ground-based projects will continue to use this method to search for, and likely find, many potentially habitable extrasolar planets. These are extremely exciting times for planet hunters. We are finally on the verge of answering the most intriguing question in planetary science: "Is there another place like home?" **A**

Laurance R. Doyle is an astrophysicist with the SETI Institute in Mountain View, California and is codirector of the TEP Observing Network. He teaches Life in the Universe at the University of California, Santa Cruz.

Hans J. Deeg is an astrophysicist with the Instituto de Astrofisica de Canarias in Spain, codirector of the TEP Network, and a member of the European COROT Spacecraft Photometry Team.

Jon M. Jenkins is a principal investigator with the SETI Institute, member of the Vulcan camera project, and a coinvestigator with the NASA Kepler Spacecraft Mission.

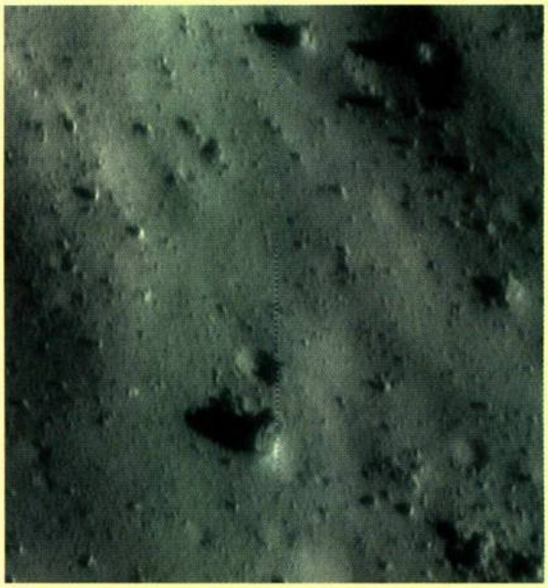


A NEAR Lo

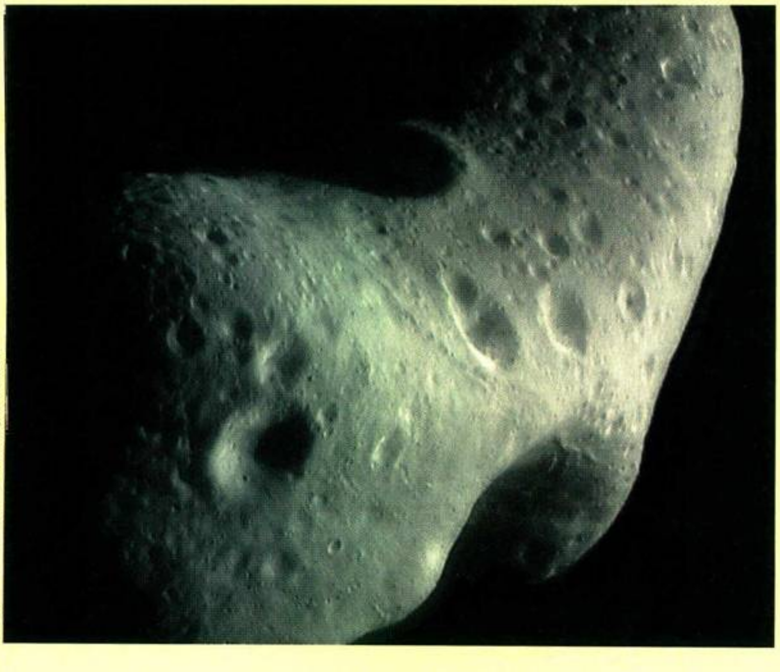
In orbit for a year, the NEAR spacecraft is revolutionizing our

Three years after special-effects asteroids pelted us in the movie *Armageddon*, these misbegotten rocks of the solar system have become much more than rocky horrors. Asteroids are finally getting their scientific due. Surprisingly, the richly detailed pictures of asteroid Eros taken by the Near Earth Asteroid Rendezvous (NEAR) Shoemaker spacecraft don't surprise some asteroid experts. "It looks like most of us thought it would look," says planetary scientist George Wetherill of the Carnegie Institution of Washington.

The new Eros images also are confirming existing ideas about the relationships between asteroids and meteorites, interplanetary debris that eventually falls to Earth. "The field is coming of age," says MIT planetary scientist Richard Binzel. "We are getting better and better links between asteroids and meteorites. For example, Eros is a fairly common type of asteroid and it looks like its composition matches the most common type of meteorite."



From less than 5 miles high, the camera records rocks as small as 5 feet across (the big boulder spans 50 feet).

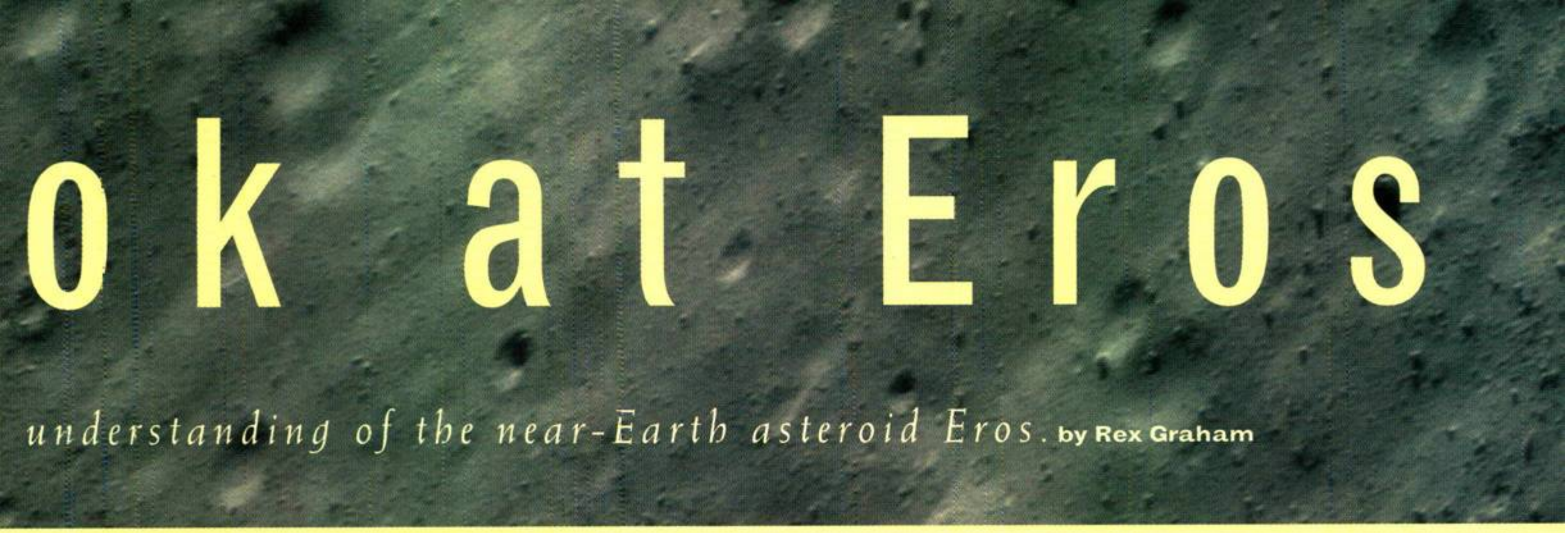


A NEAR Shoemaker view of the northern hemisphere of Eros captures the Saddle (bottom), the rim of Psyche (top), and a system of ridges that runs between them.

All photos: Johns Hopkins University and NASA

Most asteroids reside in the main Asteroid Belt, which lies between the orbits of Mars and Jupiter. It is an unstable refuge. Jupiter's strong gravity can jostle these floating boulders, mountains, and miniplanets, sending them into the inner solar system. Jupiter also can eject them from the solar system or shove them into crisscrossing orbits that favor close encounters with planets like Earth. "Things are always colliding with other things in the main Asteroid Belt," says MIT astrophysicist Jack Wisdom.

Asteroid 433 Eros, named after the Greek god of physical love, is a fragment of a much larger asteroid that formed 4.5 billion years ago and shattered later in one of those collisions. (The number 433 means Eros was the 433rd asteroid to have its orbit calculated.) "There are lots of asteroids that look spectrally similar to Eros," says Andrew Cheng, a NEAR planetary scientist at Johns Hopkins University's Applied Physics Laboratory. "What is remarkable is how uniform Eros is. There's also a good possibility that it is a small chip of a much larger asteroid, and there probably are siblings out there."



ok at Eros

understanding of the near-Earth asteroid Eros. **by Rex Graham**

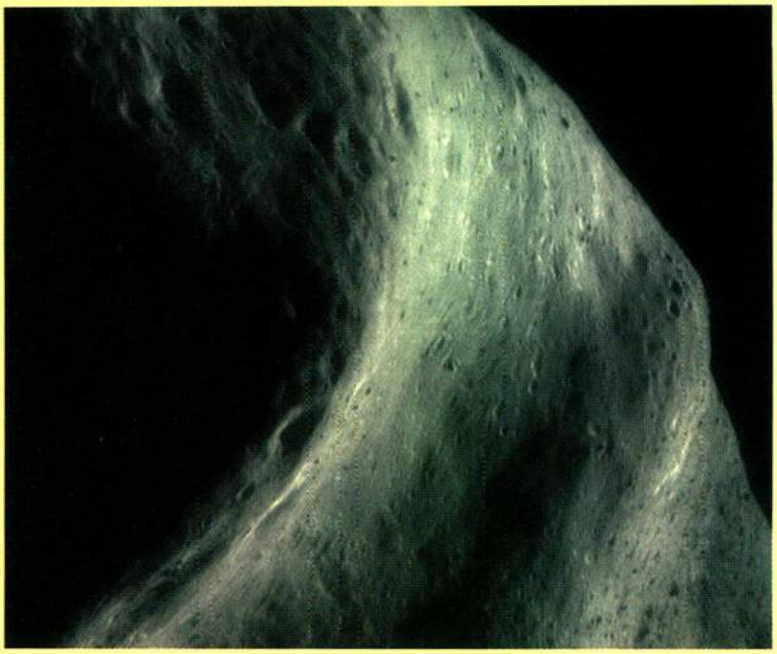
Eros is one of the largest near-Earth asteroids — a group of about 1,000 asteroids at least 0.62 mile (1 km) in diameter (only 400 have been discovered so far) plus countless smaller objects that come within 1.3 astronomical units of the sun. (One AU is the average distance between the sun and Earth, about 93 million miles.) Eros was an ideal target for the NEAR spacecraft because of its size and orbit, which brought it close to Earth at the right time for a launch. The NEAR probe, equipped with six sensors and detectors, was to complete its study of the asteroid in February and then gently crash-land on its well-photographed surface. In addition to becoming a spacecraft graveyard, Eros already rates as the smallest object ever orbited by a spacecraft.

Coincidentally, this year marks the 200th anniversary of Italian monk Giuseppe Piazzi's discovery of the first asteroid, 1 Ceres. At 596 miles (960 km) in diameter, Ceres still ranks as the largest of the roughly 128,000 known asteroids. (As of November 2000, 18,283 of these have had their orbits determined.) Eros was discovered on August 13, 1898, by Gustav Witt, director of the Urania Observatory in Berlin, and independently observed that same night by Auguste H.P. Charlois in Nice, France.

Eros measures 21 miles long, 8 miles wide, and 8 miles thick (34 by 11 by 11 km). Shaped like a ballerina slipper, it rotates once every 5.27 hours — toe to heel to toe. Despite its rather odd shape, chemically the asteroid is not an oddity. NEAR has confirmed that Eros is solid and not a rubble-pile collection of smaller fragments, as some planetary scientists had suspected. Measurements also show that while the asteroid has a uniform density — the same as Earth's crust — its surface has not been heated and separated into layers by geologic processes that operate on Earth.

NEAR's instruments have found that the relative abundances of magnesium, aluminum, iron, silicon, and other elements on the surface of this so-called S-type asteroid match those of the ordinary chondrites, the most common type of meteorites. These meteorites contain the same chemical constituents as the sun in the same relative proportions, but without volatile gases such as hydrogen and helium. (The name chondrites comes from the Greek word for "seed," which is what the beads of flash-heated silica, or chondrules, look like. Achondrites, or meteorites without chondrules, are far rarer and likely result from the melting of material within asteroids.)

NEAR's camera has returned thousands of images of the asteroid's pockmarked surface. The most prominent feature is a 6.2-mile-long (10-km) depression dubbed "the Saddle," which may actually be a worn-down crater. Eros also claims a 3.4-mile-diameter (5.4-km) crater and about 100,000 additional craters wider than 50 feet (15 m) across. Some collections of craters have whimsical appearances: a face, a cat's paw, the five Olympic rings, and even a waffle pattern of nearly square pits. Roughly 1 million boulders the size of a house or larger cover the surface of Eros. The asteroid also has cliffs, a loose covering of rock and dust called regolith, and linear surface features that may be related to cracks created from ancient impacts.



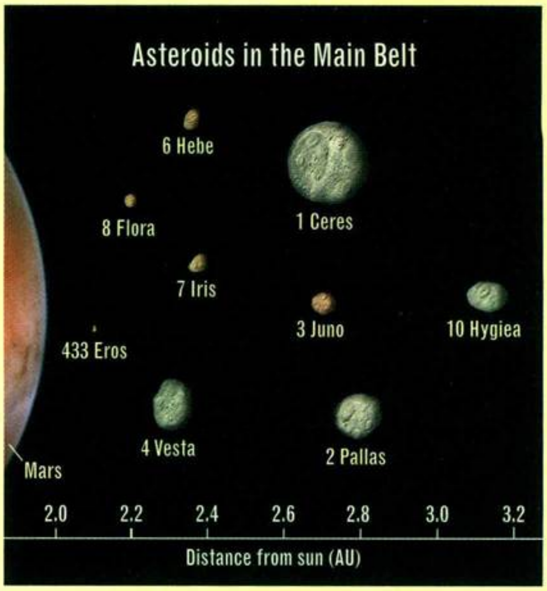
The huge size of the Saddle comes out in this image mosaic. A particularly boulder-rich region covers the southwestern part of the Saddle, visible at lower right.

NEAR (Miss) Mission

Launched in 1996, the $224-million NEAR spacecraft began an automatic series of engine burns on December 20, 1998, that were intended to slow it down in preparation for further maneuvers designed to put it into orbit around Eros several weeks later. However, concurrently with the burns, the 9-foot-long, 1,775-pound (800-kg) craft began to behave erratically. Ground controllers lost communication with it for 27 hours while the spacecraft fired its thrusters thousands of times. Scientists and engineers at The Johns Hopkins University's Applied Physics Laboratory regained control of NEAR, but not before it had burned much of its fuel. The controllers barely rescued the mission, putting the spacecraft on a new trajectory that allowed it to rendezvous with Eros 13 months later than planned. (The remaining fuel was just enough to carry out the mission.)

NEAR's remarkable recovery has generated a steady flow of images and measurements. Excitement among the members of the imaging team grew as the spacecraft dropped closer to its uniformly brown target. "Eros had looked like the surface of the moon during the first couple months of the mission, but as the spacecraft got closer it really didn't look like the moon at all," says Clark Chapman, an asteroid expert and imaging-team member with the Southwest Research Institute in Boulder, Colorado. "Eros has many more boulders and far fewer craters than the moon. I don't understand it."

While NEAR data reveal striking similarities between the asteroid and ordinary-chondrite meteorites, the images also give tantalizing clues about the geology of Eros. For example, crater rims that are straight instead of curved suggest that the impacts that made them occurred along fractures. The geological insight is fitting for the mission. NEAR was renamed "NEAR Shoemaker" a year ago as a tribute to renowned astrogeologist Eugene Shoemaker, who died in 1997 while traveling to impact craters in the Australian outback. Shoemaker's desk at the U.S. Geological Survey in Flagstaff, Arizona, had been perpetually piled during his lifetime with meteorite fragments and impact-melted debris. Shoemaker pioneered the study of asteroid collisions in shaping planets, and he once reportedly said he wanted to tap a rock hammer on Eros. Indeed, it is conceivable that pieces of Eros's fractured parent have fallen to Earth as meteorites, and one or more of them may have ended up on Shoemaker's desk.



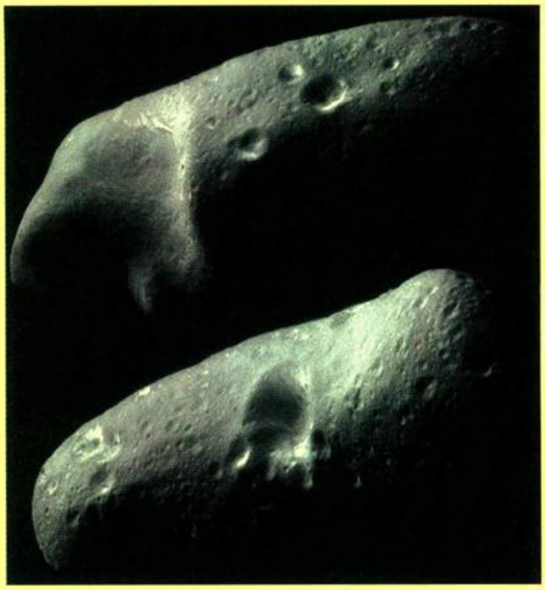
Eros, tiny when compared with its larger siblings, has an orbit that takes it from near Earth to beyond Mars.

A chance clustering of craters resembles the Olympic rings. The asteroid's weak gravity means debris from impacts lands far away, preserving nearby features.

The Meteorite Connection

Scientists have picked up roughly 9,000 dark-colored meteorites while traversing Antarctica's ice fields in the past few decades. Many of these meteorites appear to be from asteroids, planets, or conceivably even comets. Meteorites have been found in virtually every country on the planet, and those presumably from asteroids have been classified into a variety of distinct types based on their constituents and appearances.

Planetary scientists think that the various types of asteroids (and the meteorites that come from them) formed in specific zones in the main Asteroid Belt. For example, the Tagish Lake meteorite, which fell in Northwestern Canada on January 18, 2000, is a carbonaceous (carbon-containing organic material) chondrite. "We think it might match a C-type asteroid," says Binzel. "These are asteroids that are generally farther from the sun, in the middle of the main Asteroid Belt and outward. We also have the ordinary chondrites, meteorites that have been heated but not melted, and those are generally from asteroids found on the inner half of the Asteroid Belt. And



The Saddle dominates the eastern hemisphere of Eros (top), while Psyche rules the western hemisphere.

that's what Eros is — an S-type asteroid that ended up in a near-Earth orbit."

The third-largest asteroid — 4 Vesta — is the only surviving asteroid known to have had volcanic flows on its surface 4.5 billion years ago. Binzel says an impact on Vesta most likely chipped off a huge "swarm" of fragments that have similar orbits in the Asteroid Belt. He adds that the movement of the fragments away from Vesta toward the inner solar system — "like a trail of bread crumbs" — strongly suggests that many of the fragments probably fell to Earth as basaltic-achondrite (fine-grained igneous rock) meteorites. "The spectral properties of Vesta's surface identically match the spectral properties of these HED (Howardites, Eucrites, and Diogenites) meteorites," says Binzel.

Eros now is classified as an Amor, a class of near-Earth objects whose orbits take them only as close as 1.3 AU to the sun. (Apollos and Atens are two classes of Earth-crossing asteroids whose orbits lie primarily outside or inside, respectively, Earth's orbit.) "Eros probably escaped the main Asteroid Belt when the eccentricity of its orbit increased," says Chapman. "We think Eros and Eros-like bodies may bounce around in Earth-approaching orbits for tens of millions of years before their orbital eccentricities increase even more, which is when possibly 5 percent run into Earth or another planet. Their orbits also could become more eccentric and they could dive into the sun, or maybe get sent back out toward Jupiter and escape the solar system."

The fate of Eros and other near-Earth asteroids are unpredictable because close encounters with Mars and Earth change their orbits. The picture is complicated because the planets' orbits themselves aren't fixed. They are primarily influenced by the sun's gravity, which puts them into elliptical orbits. The planets also exert gentle gravitational pulls on each other that distort their orbits away from a purely elliptical shape. These "secular perturbations" cause the points at which each of the planets are closest to the sun (the perihelion points) to precess, or rotate counterclockwise, in space. Such perturbations cause Earth's orbit to precess with periods of 19,000 to 1,000,000 years.

This and other perturbations gently but continually disturb the orbits of near-Earth asteroids such as Eros. "There are a whole batch of things that affect asteroid orbits, especially the asteroids that are in the vicinity of Eros," says Joseph A. Burns, an astronomer at Cornell University. "It's like a couple of boxing bags swinging back and forth: Sometimes one bag bounces off the other bag and its orbit is totally different on the next swing. And while that is happening, other forces are pushing on both bags at different frequencies." The unfortunate result for near-Earth asteroids is that they have chaotic orbits that are impossible to predict with certainty beyond about 100,000 years.

"Eros's chance of eventually hitting Earth on a 1-million-year timescale is about 10 percent," says Burns. Even such a remote chance is important, because scientists think Eros is much larger than the object that made the Chicxulub crater in Mexico's Yucatan Peninsula about 65 million years ago. That impact is thought by many scientists to have doomed the dinosaurs, or at the very least contributed to their demise. Burns says there is no cause to fear Eros, even if it may eventually hit Earth. "The mathematical simulations are quite clear — it can't happen for at least 100,000 years." ▣

Rex Graham is a senior editor of Astronomy.

Psyche ranks as the largest crater on Eros. The bright areas likely formed when dark material rolled downhill and revealed fresher material underneath.

In Search of Fresh Fall

A prolific meteorite hunter snags his prey.

by Tom Yulsman

It's not every day that Larry Pardue flies 100 miles just to have breakfast. But on the morning of June 13, 1998, the airport at Denver City, Texas, was hosting a fly-in breakfast. To Pardue and three friends, bacon and eggs in Texas seemed like the perfect excuse to get out of town on a Saturday that was shaping up to be a scorcher.

And so at a little after 7, Pardue and his friends took off from Carlsbad, New Mexico, in a Piper Cherokee. A friend piloted the aircraft; Pardue road shotgun. At 7:30, flying at 5,500 feet, Pardue gazed out at a typical late-spring cloudscape of Western skies: A scattering of puffy cumulus were off to the north, casting shadows on the buff-colored plains below.

Suddenly, his reverie was broken by a brilliant flash in his peripheral vision. To the north, he saw a flame shooting down. In less than a second, it neared the horizon. Then it vanished as quickly as it had appeared. Pardue grabbed the controls and pointed the aircraft toward where he had seen the flame. He noted the compass heading: 012 degrees — directly toward the town of Portales, New Mexico.

On that same morning, Skip Wilson had no idea that he was about to win the cosmic lottery. His mind was occupied by more mundane affairs, such as the heat and drought afflicting Portales. In overalls and work boots, Wilson, 60, cuts the figure of a man accustomed to physical labor, and just maybe hard times. His rectangular face bears

The daunting search for meteorites often begins in locales that resemble a Mars-scape.

All photos by Will Van Overbeek unless otherwise credited

evidence of long days spent out on the bright plains along New Mexico's border with the Texas panhandle. The sunburn extends from the tip of his nose on down, leaving his forehead and the skin around his gray-blue eyes pale — protected by a "Farmers and Ranchers Realty Co." baseball cap.

Judging by the ordinary details of his life, one might never suspect that Wilson has made important contributions to research into the origin of the sun and planets. He has done this as a kind of fossil hunter. But his quarry is rarer, harder to find, and more unusual than your garden-variety fossil. Instead of the bony remains of dead creatures, Wilson hunts stony remains of long-disintegrated planetessimals — rocky bodies, smaller than planets, born 4.6 billion years ago as the solar system was condensing out of a cloud of gas and dust.

Scouting Out the Remains of Asteroids

Wilson's fossils are, of course, meteorites. And locked within them are chemical and physical traces of the origin of the sun and planets. By snaring more than 200 meteorites since 1967 — by some estimates, more than any person alive today — Skip Wilson has helped advance the science of solar system origins.

His exploits are the envy of his fellow meteorite hunters. "Skip is a hero to all of us meteorite heads," comments Bob Haag, a renowned meteorite collector and dealer in Tucson. Mike Farmer, another dealer in Tucson, goes further: "He's like God to us." In 1998, after nearly 30 years of successful hunting, there wasn't much more for Wilson to accomplish. But he did harbor one improbable dream: to collect specimens from what's known in the trade as a "fresh fall" — a meteorite that has just crashed to Earth. The odds of Wilson in particular being at ground zero as a meteorite crashed to Earth had to be slim indeed.

Larry Pardue, left, was out flying one morning with pilot George West when he spotted a meteorite falling toward Portales, New Mexico.

Linda West

At 7 A.M., just as Pardue was lifting off from Carlsbad, Wilson stepped outside to water his thirsty flowers and tomato plants.

At about the same time, and just a few miles from Skip's place, Nelda Wallace, a 70-year-old widow and art teacher, was fixing coffee for her sister and brother-in-law, Fred Stafford, who were visiting from California. Out the window, Nelda spotted a few isolated cumulus clouds hovering not far to the south, in the direction of Carlsbad. The coffee was ready at almost exactly 7:30. Nelda carried the steaming mugs into the living room, where her guests were waiting. "I had just sat down and kicked my shoes off when we heard this very loud boom," she recalls.

Nelda glanced anxiously over at Fred.

"Oh gee, now what was that?" she said.

Then they heard a second explosion. Nelda and Fred ran out the door to a porch overlooking the parched fields in back of her house. They were met by a roaring sound.

"It's an airplane," Nelda exclaimed. She and Fred looked for signs of a stricken plane. Nothing. But the roaring got louder, and then a third boom rumbled across the plains followed by a series of pops and crackles.

"It sounds like it's going to hit the house," Nelda said.

The roaring got louder still. To Fred, it now sounded like an incoming mortar round. "I THINK IT'S GOING TO CRASH THROUGH THE ROOF!" he yelled. And then he jerked his arm toward the southwest, pointing up in the sky: "HERE IT IS!" As Nelda followed Fred's gesture, she saw an object streaking directly toward them, vapor trailing behind.

At about the same time, Gale Newberry was getting ready to begin his daily routine as a peanut farmer. With sandy hair, blue eyes, blonde, bushy eyebrows, and a mustache that's almost but not quite a handlebar, Newberry looks younger than his 58 years. His quick smile, ready laugh, and easygoing manner belie the hardships that a family farmer must routinely endure. Newberry left the house at 7:30 to move a sprinkler. Then he heard the explosions.

"I heard seven or ten of them, and they were so powerful that I could feel the concussions," he says. Because the sound had come from the direction of an alcohol plant in town, he thought there might have been an accident there. "So I went back to work and half forgot about it."

"Smoke" Trails and Weird Debris

Between 7:30 and 7:45, Newberry went to his brother's house. There he met his 22-year-old son, Jerrod, who reported that he had seen smoke trails in the sky and heard a loud explosion directly overhead. The Newberrys wondered whether some fighter jocks from Clovis Air Force Base had broken the sound barrier; however, that didn't really explain the weird debris trails. But during the growing season, farmers have more important things to do than ponder mysterious booms. So Gale and Jerrod went back to work.

When Skip Wilson had finished watering his plants, he returned to his house. "Just as I got inside, I heard two sonic booms followed by this 'POP-POP-POP-POP-POP,'" he says. "Well that got my attention. So I ran outside and looked up."

Wilson saw an object streaking high and fast overhead, a cloud of vapor boiling around it and a corkscrew-shaped

Meteorite hunters often use metal detectors in their chase.

contrail emanating behind it. Like Nelda Wallace, he first thought it was from a stricken airplane. Back at Nelda's place, she and Fred Stafford had never seen anything quite like the smoking object streaking toward the house. Luckily, it just missed; it impacted a mere 100 yards from where they stood in stunned amazement.

"When it hit, it kicked up a huge cloud of dust," Nelda says. "And it went THUD, like the sound you would hear if two cars crashed about a quarter mile away from you."

The dust cloud quickly mushroomed to several hundred yards wide. Nelda ran back in the house to get her shoes, and then she and Fred raced out to the field. At first, they couldn't find the impact site because dust and sand were swirling abrasively. But in a minute or so, Fred found a crater. It was about 10 inches deep and a foot in diameter. Sticking two inches out of the hole was a dark object with a teardrop shape. The grayish-black object was too hot to handle, so with booms still echoing around them, Fred and Nelda retired to the house to wait for things to calm down.

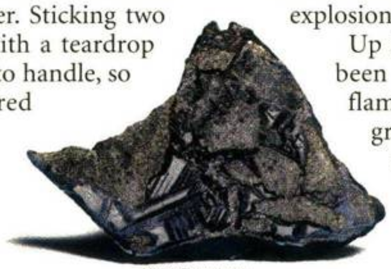
About 45 minutes later, they returned to the crater to check on the mysterious object. By that time, it had cooled enough to handle, and Fred picked it up. It was bigger and far heavier than a bowling ball, and its surface was charred black. It also seemed shot through with shiny metallic veins.

About an hour later, Gale Newberry entered his barn. "I went into the back room. The lights were off, so it was dark." But then Gale saw a spot of sunlight on the wall. There are no windows in that part of the barn.

"What in the world is that?" Gale thought to himself. As he followed the shaft of light leading up from the spot on the wall to its point of origin, he saw an 8-inch by 5-inch hole in the roof. At this point, his son, Jerrod, and brother, Roy, entered the barn. "We got to lookin' down near that spot of light on the wall, and we saw a hole in the insulation," Gale says. "Then Jerrod just reached in behind the insulation, and wouldn't you know it, he pulled out a rock."

The explanation for the potato-sized object Jerrod was holding seemed clear: It had to have come from space.

"We figured out pretty quickly that it must be a meteorite," Gale says. "Now, I know Skip fairly well — we went to school together. I knew he was a meteorite hound, and that he had been doing this for years. So I called him up and I said, 'Skip, are you very busy? I got something to show you.' And he said, 'Does it have anything to do with those explosions?'" Gale told him to just come on over.



Maria Schuchardt

Up in the Piper Cherokee, Larry Pardue had been utterly astonished by the intensity of the flaming ball he had seen streaking toward the ground. "I've seen fireballs at night, but certainly nothing during the daytime near this bright," he says.

His conclusion: A massive meteorite had just fallen to Earth. And he had a hunch that it must have exploded above the ground, scattering shrapnel around the countryside. He was exactly right. One of those fragments had slammed into Nelda Wallace's field, while another had sliced through the roof of Gale Newberry's barn.

As Wilson got ready to head over to Newberry's house, an extraordinary thought hit him with a jolt of adrenaline: Was his fervent wish to collect meteorites from a fresh fall coming true, right before his eyes? It was too bizarre to believe.

When Wilson arrived at his friend's house, Newberry said, "Hey Skip, I'm gonna make your day."

"And boy, did he ever," Wilson says.

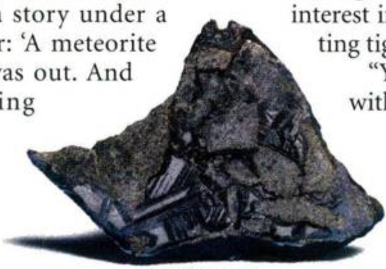
Veteran meteorite hunter Mike Farmer combs the southwest for prey.

According to scientific reconstructions, the Portales Valley Meteorite likely streaked into the atmosphere at 20,000 miles per hour. Roughly a yard across and weighing more than 200 pounds, it was crushed by increasing air pressure. As it neared Portales, it finally exploded, throwing off three large pieces. Moments later, as the largest pieces continued streaking toward the northeast, there was a second explosion, which showered many smaller fragments over Portales in a field six miles long by a mile wide.

Now that he was holding one of these fragments in his hand — a dark gray spud of a rock weighing a pound and scorched in places — Wilson acknowledged what he had known in his heart all along.

Gayle Newberry called the local newspaper, and a skeptical editor and photographer came over to have a look. The next day the *Portales News-Tribune* ran a story under a journalistically cautious headline: "Farmer: 'A meteorite crashed into my barn.' " Now the news was out. And as Skip Wilson puts it, "Man, this thing just went crazy."

By Monday morning, Mike Farmer from Tucson was knocking at Gale's door. He was, according to Gale, determined to buy pieces of the meteorite. And within minutes of seeing the rock that had punched through the roof of the barn, Farmer offered to buy it for $1,500. Gale turned him down flat.



Maria Schuchardt

At about noon, Gale was working out in his fields when he saw a hulking Humvee approaching his house with an ultralight aircraft strapped to the top. At the wheel was a man with shoulder-length hair and dark sunglasses: Robert Haag, perhaps the most colorful meteorite dealer in the world. Haag had arrived to make an offer for Gale's meteoric discovery. But as he did with Farmer, Gale turned him down.

By this point, newspapers and television were spreading stories of the Portales meteorite fall. Wilson appeared on television news. If all that were not enough to work folks into a frenzy, Haag got on a Portales radio station to say that he had thousands of dollars to spend on pieces of the meteorite.

"That sure got folks to huntin'," Gale says with a grin. And not just for the fragments. One of the hunters cut a small crater out of a road where fragments had landed. By the 16th, a media-shy Nelda Wallace had told her story to the *Portales News-Tribune*. The front page was anchored by a photo of her beside a 37-pound fragment.

The picture got Haag's attention, and it wasn't long before he drove up to Nelda's place in his Humvee. According to her, he offered $500 just to look at the meteorite. But she is an independent spirit. And given the dealers' intense interest in the meteorite fragments, she knew that sitting tight for a little while wouldn't hurt.

"You know, this is not my first rodeo," she says with just a trace of amusement.

Meanwhile, Wilson busily scoured the Portales area over the next weeks. He came up with six fragments of the meteorite, more than 20 pounds. It was the impossible dream come true — "almost a fairy tale for me."

"Of course it's always goin' through your mind, you're out huntin', and you think, 'Man, it'd be neat if I could see this sucker come screamin' in.' The chances are it's not gonna happen. But yet it did. It was close enough to where I heard it, I seen the visual effects of it, and then I got to go out and pick up fresh meteorites from it.

"These others I find, when I pick one up, I know I got somethin' in my hand that's old, old, old, and come a long, long ways. Very few other people get to do that. But this, now this was the highlight of my meteorite huntin' experience."

There was even more reason for Skip to be thrilled. As it turned out, scientific analysis has revealed that the Portales Valley meteorite is quite unusual — in some respects, unlike any meteorite in its class ever found. It has already yielded new details about events that occurred on a long-lost miniplanet, called a planetesimal, that circled the young sun in the very earliest days of the solar system.

Scientific analysis of the Portales Valley meteorite began not long after its spectacular landfall. Within a few weeks, Nelda donated an 11-gram piece of her chunk to the University of New Mexico's Institute of Meteoritics in Albuquerque. (Nelda would later sell the lion's share of her chunk to a consortium of universities for a whole lot of money.) When UNM meteoriticist Adrian Brearley first saw it, he was struck by the thick metal veins crisscrossing the sample. "I was quite taken aback by it, really — quite astonished by its appearance," he says. "It was unlike any meteorite I had ever seen."

What accounted for the spectacularly unusual nature of the Portales Valley meteorite? At the University of Arizona in Tuscon, meteoriticist David Kring would find the answer, using specimens donated by Mike Farmer and Robert Haag.

Kring's group used an electron microprobe to tease out details about the meteorite's composition. First, they cut a slice from the meteorite100 times thinner than a human hair. In the microprobe, they bombarded this ultrathin section with a beam of electrons. This caused atoms within the section to emit x rays. By analyzing the energies and wavelengths of the x rays, Kring's group determined the chemical composition of the minerals in the sample. With this and other analyses, Kring and his colleagues decided that they were working with a type of meteorite known as an H6-chondrite. All H-chondrites are believed to have come from a single planetesimal that formed 4.6 billion years ago.

Chondrites contain millimeter-sized spheres, called chondrules, that consist of olivine and pyroxine crystals embedded in a silicate matrix. The chondrules are thought to have originated early during the solar system's birthing process. According to this theory, tiny balls of dust orbiting around the young sun were melted, forming little droplets of molten material. As the droplets floated amidst dust and gas of the early solar system, they cooled and solidified. Eventually, they accreted with other orbiting material to form planetesimals. These miniplanets — toddlers on the planetary growth scale — are thought to be the parent bodies of the majority of meteorites. (Also the progenitors of planets.)

By analyzing the nature and size of chondrule minerals from H6-chondrite meteorites, scientists have estimated that the parent planetesimal was about 125 miles in diameter — roughly the distance between Los Angeles and San Diego. Now, with the addition of the Portales Valley meteorite to the collection of objects from the parent, Kring and his colleagues were able to flesh out new details about its history. The key was the prominent metal veins. To Kring and his colleagues, they suggest that an asteroid smashed into the planetesimal, gouging a large crater and creating mayhem in the miniplanet's interior.

The scenario goes like this: Metal once was distributed in flecks and specks in stony parts of the planetesimal. Then this stone was heated to the melting point, enabling the metal to move and collect in cracks. A large impact on the parent body would provide the requisite heat and crack the surrounding rock. The pressure from the impact would squeeze the now-molten metal into newly opened fractures.

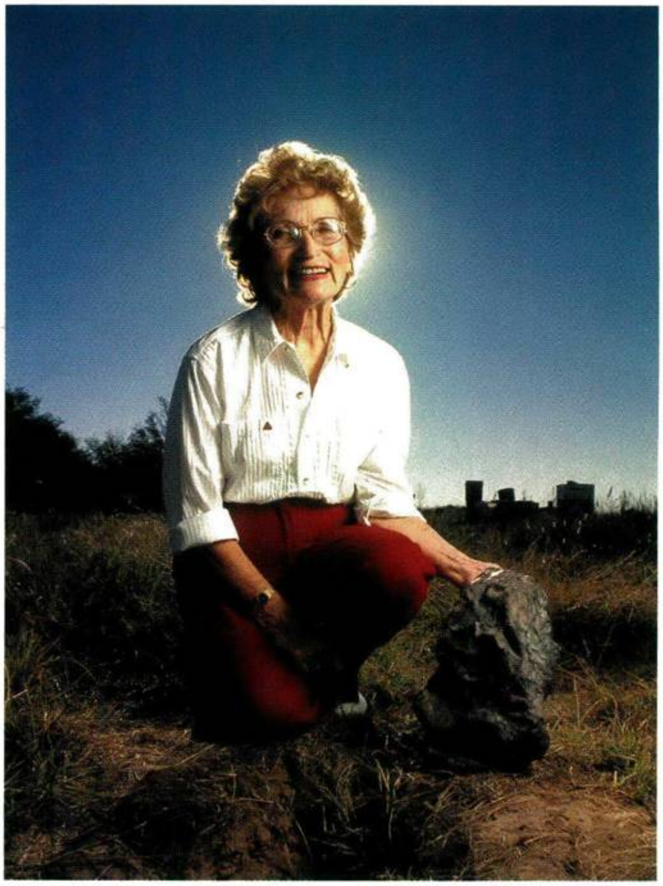
Based on the crystalline structure of the metal in the veins, Kring concludes that it cooled and solidified extremely slowly — perhaps only a few degrees per million years. For such slow cooling to have occurred, the veins must have been buried deep within the asteroid, where the overlying rock would have effectively prevented interior heat from escaping. Kring's best estimate is that the Portales meteorite's metal veins were formed at least four miles deep within the parent planetesimal. He calculates that the crater made by the impact should have been nearly 25 miles across.

Of course, the story doesn't end there, because somehow the veined rock sitting 4 miles deep within a miniplanet had to find its way to Skip Wilson's neighborhood on June 13, 1998. To make that possible, big chunks of the planetesimal first had to break off, including a piece carrying the future meteorite. And then that piece had to become fragmented and the fragments fragmented until a metal-veined boulder about a yard across was created. Since the Asteroid Belt is littered with all manner of debris, a simple game of cosmic bumper cars over a billion years could have done the trick.

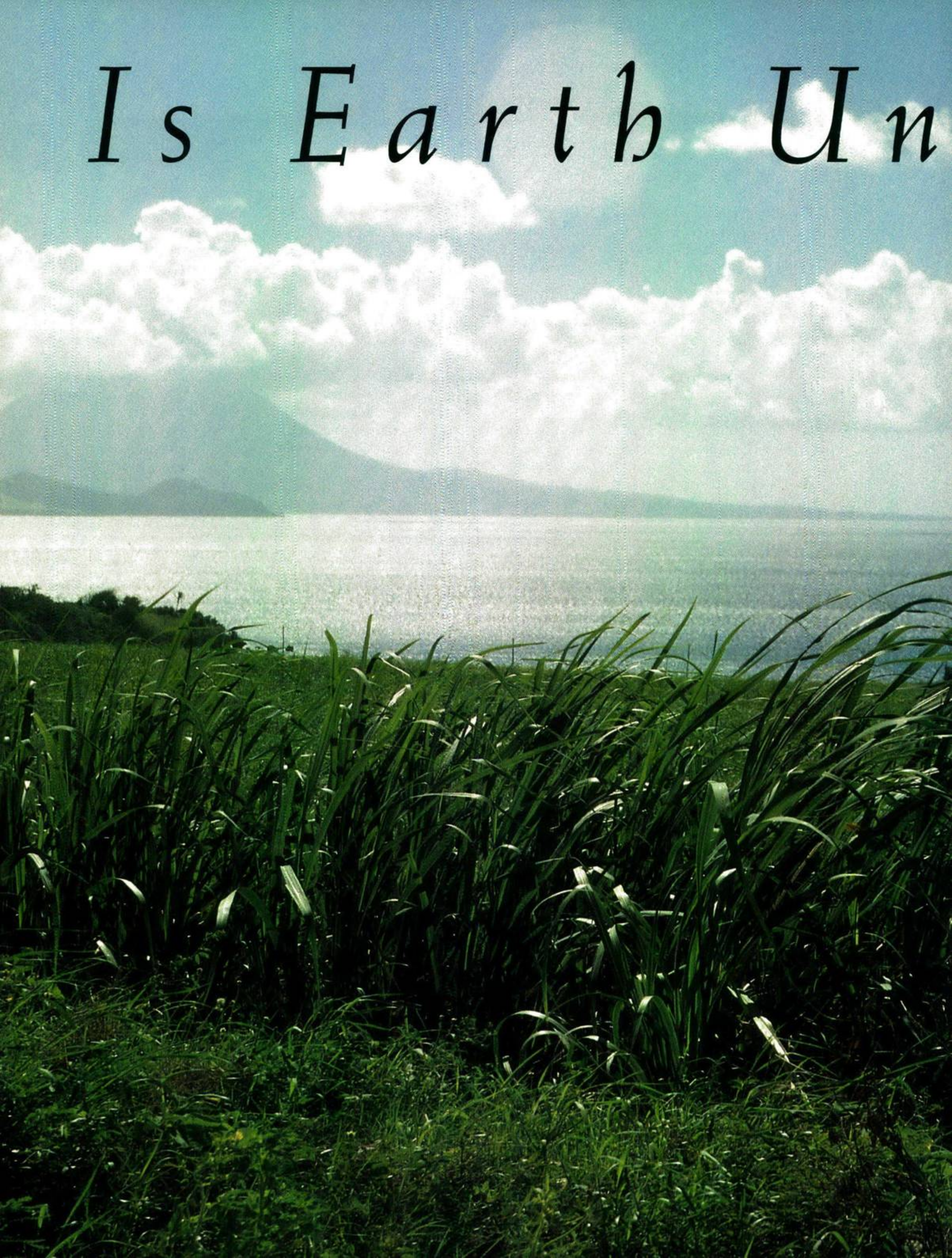
By chance, the boulder's ride in the Asteroid Belt ended when it swung by Jupiter's gravitational field into an Earth-crossing path. And simply by chance, the boulder found itself streaking toward the very town where Skip Wilson, one of the greatest meteorite hunters of all time, was waiting to receive it. And that's how Wilson won the cosmic lottery. ■

Tom Yulsman, a contributing editor to Astronomy magazine, teaches science journalism at the University of Colorado.

Nelda Wallace found a big chunk of the Portales meteorite in her yard.



Is Earth Un



ique?

Odds favor abundant life in the cosmos, but so far, we're it.

Adapted by Martin Rees from *Just Six Numbers*
Photos by Carol Ryback

In the 19th century, Darwin and the geologists deduced that Earth and its biosphere were the outcome of at least a billion years of evolution. We now view our solar system in a still grander perspective. Our sun is just one of a hundred billion stars in our Milky Way, which is itself just one galaxy among billions of others. The whole cosmic tapestry can, we believe, be traced back to the initial instants of a Big Bang. But how unique is Earth in this vast cosmos?

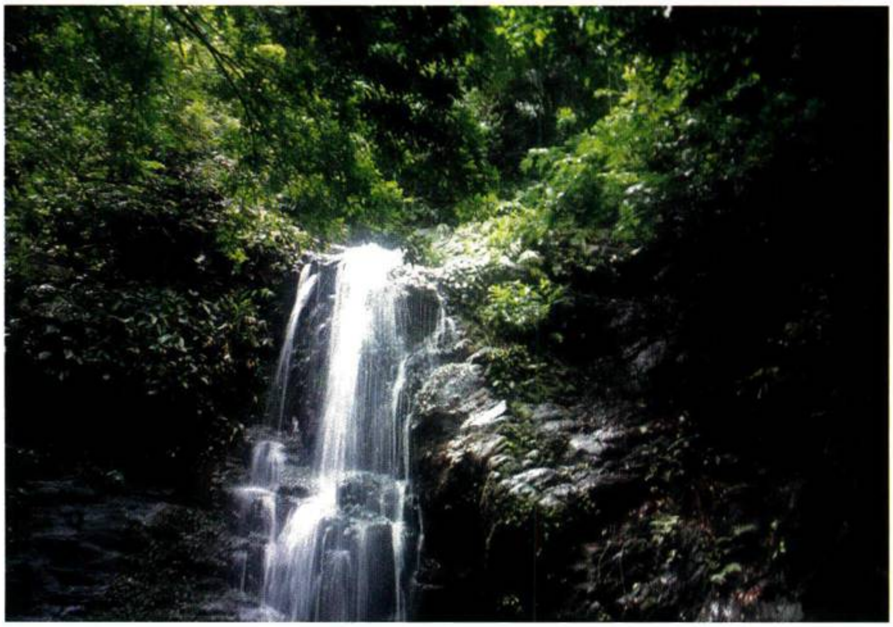
Of the many environments in the solar system and beyond, only one is known to harbor life — Earth. Lush ecosystems, such as found in the Caribbean, host a wealth of Earth's wonders.

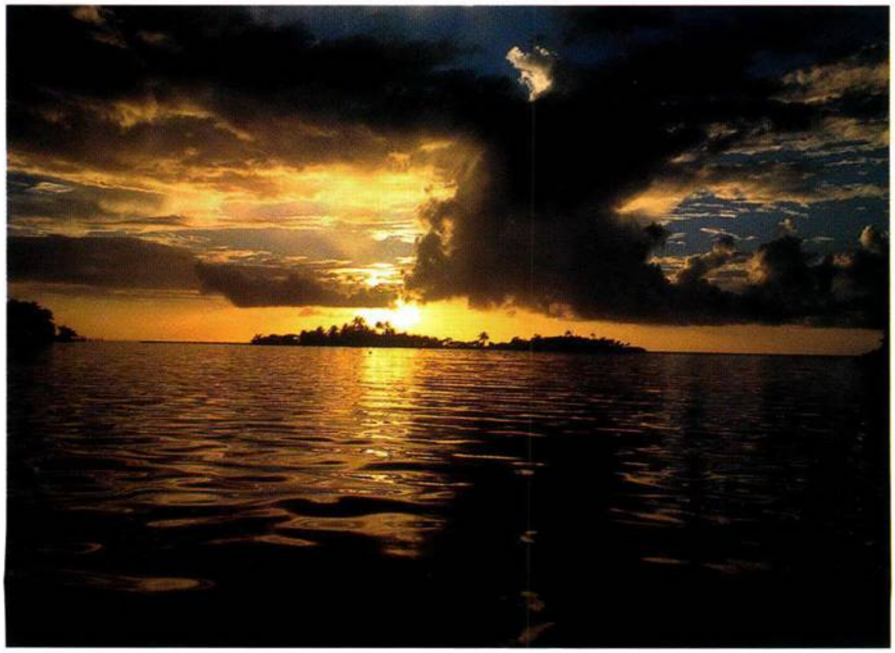
Planet Search

Astronomers have long suspected that other stars are orbited by planets, but firm evidence eluded us until a few years ago. Even now, the only planets we can detect are very large ones — the size of Jupiter. But there's every reason to believe that these are also the largest members of other solar systems and that planetary systems are so common in our galaxy that Earth-like planets may number in the millions.

The United States has a larger and more ambitious space program than Europe — a legacy of the Cold War. While NASA's hugely expensive manned International Space Station is neither practical nor inspiring, the better news is that NASA's Chief Executive, Dan Goldin, is also focusing on a less expensive unmanned effort: The Origins program, aimed at probing the genesis of stars and planets, of life, and of the entire universe itself (see "Looking for Life," December 1999).

Everyone is familiar with the layout of the solar system — the sizes and orbits of the nine major planets. To casual observers, stars are remote points of light. Twenty or 30 years from now, the night sky will seem far richer and more interesting. New astronomical surveys will reveal undiscovered planetary systems, orbiting hundreds of other stars. We will know the sizes and orbits of nearby stars as well as their retinue of planets, (and even some topographic details). Sky charts will be much more intricate.





Twins of Earth

We'll be especially interested in possible twins of Earth — planets the same size as ours, orbiting other sunlike stars, and with temperatures that allow water to neither freeze nor boil. Large telescope arrays in space will reveal Earth-like planets that may orbit our stellar neighbors.

Might they harbor life? Life on Earth occupies an immense variety of niches. We still don't know how or where it all started. Was it in Darwin's warm little pond, far underground, or even in dusty molecular space clouds? Deep ocean-bed ecosystems near sulfurous outwellings tell us that not even sunlight is essential.

The emergence of life may be a routine event in the cosmos; on the other hand, it may be hugely improbable — we just don't know. This is a question for biologists. But biology is a harder subject than astronomy. Stars and galaxies may be vast and remote, but they are far less complicated than living organisms, with layer upon layer of intricate structure.

We only know about our own biosphere; therefore, we can't dismiss the possibility that Earth resulted from a chain of events so immensely improbable that it only happened once in our galaxy. If life had emerged twice within our solar system, it couldn't be a fluke. We could then confidently infer that life existed on planets around other stars, and that the entire galaxy teemed with life. That's why it's so crucial to detect life — even in simple, vestigial forms — elsewhere in our solar system, whether on the arid surface of Mars, or under the ice of Jupiter's frozen moons, Callisto and Europa.

Scanning for Intelligence

Only in the last few years have we known for sure that worlds exist in orbit around other stars. But we are little closer to knowing whether any of them harbor anything alive. Still less do we know the likelihood that simple life

Top: A waterfall on the Bay Island of Guanaja, Honduras, reminds us that an abundance of water makes life possible on Earth.
Bottom: Earth's distance from its star provides just the right mix of temperatures and conditions to produce dramatic sunsets.

Coral reefs, the largest structures created by living organisms, rival rain forests in species diversity — yet only the very surface layer of the reef itself is alive.

would evolve into anything we could recognize as intelligent.

Systematic scans for signs of intelligence beyond our solar system are a worthwhile gamble, despite the heavy odds against success, because of the philosophical import of any detection. A manifestly artificial signal — even if it were as boring as a set of prime numbers or the digits of *pi* — would convey the momentous message that intelligence (though not necessarily consciousness) wasn't unique to Earth and had evolved elsewhere; that concepts of logic and physics weren't peculiar to human brains.

The odds may, of course, be stacked so heavily against intelligent life that there is none anywhere else in our part of the universe. While some may find it depressing to feel alone in a vast inanimate cosmos, I would personally react in quite the opposite way. If searches for extraterrestrial signals are doomed to fail, proving that Earth were the sole abode of life in our galaxy, we could view it in a less humble cosmic perspective than if the universe already teemed with advanced life forms.

One thing we've learned from astronomy is that the expanse of future time — even if not infinite — is far longer than the 14 billion years that have elapsed since the genesis event that set our universe expanding. Our own sun has burned less than half its fuel and will continue to shine for longer than it has taken for us to evolve. Even if life is now unique to Earth, there is time for it to spread through the galaxy — and beyond.

Common Cosmic Genesis

However different they and their world were from ours, aliens would be made of the same kinds of atoms and governed by the same forces as us; they would gaze out on the same vista of stars and galaxies. Were we ever to contact them, perhaps the only common culture would stem from a shared interest in how our cosmic habitat emerged from an initial genesis.

We can actually look back into the past and see evidence of this evolution. Long-exposure pictures taken with the Hubble Space Telescope show that the sky is densely covered with faint smudges of light, a billion times fainter than any star detectable with the unaided eye. These are actually entire galaxies, tens of thousands of light-years across, which appear so small and faint because they are so far away that their light set out 10 billion years ago. We see them as they were in the remote past: young stars with no planets — and presumably no life.

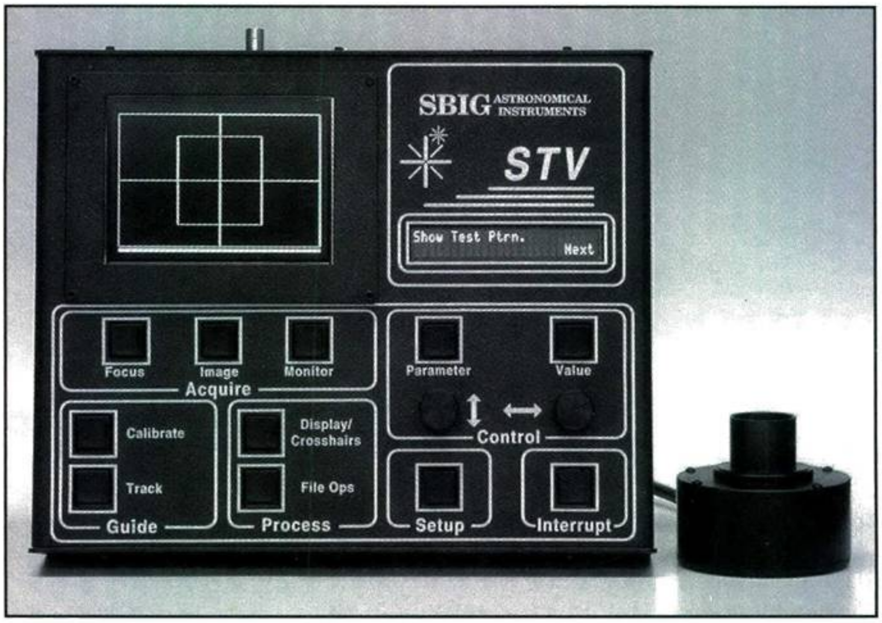
But what happened before galaxies formed, when everything was squeezed into an almost structureless gas hotter and denser than the center of the sun — a mass so simple that it can be described by just a few numbers? How did 14 billion years of cosmic evolution lead from such a simple recipe to our immensely complex cosmos? How — here on Earth and perhaps on other worlds — did atoms assemble into creatures able to ponder their origins?

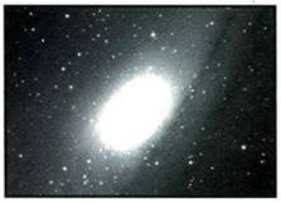
Perhaps the answers require new insights into the nature of space, time, and the links between the cosmos and the microworld. Perhaps aliens in orbits around distant suns already know the answers. But for us, these mysteries present a challenge — and perhaps an unending quest. A

Cambridge University astrophysicist Sir Martin Rees is Britain's Astronomer Royal. He is author of Before the Beginning *and* Just Six Numbers.

SBIG
ASTRONOMICAL
INSTRUMENTS

ANNOUNCES THE REVOLUTIONARY
STV


SBIG ASTRONOMICAL INSTRUMENTS
STV
Show Test Ptrn.
Next
Focus
Image
Monitor
Acquire
Parameter
Value
Control
Calibrate
Track
Guide
Display/ Crosshairs
File Ops
Process
Setup
Interrupt



The First STAND ALONE DIGITAL INTEGRATING *VIDEO* CAMERA AND AUTOGUIDER

LIKE NO OTHER ASTRO CAMERA OR AUTOGUIDER IN THE WORLD

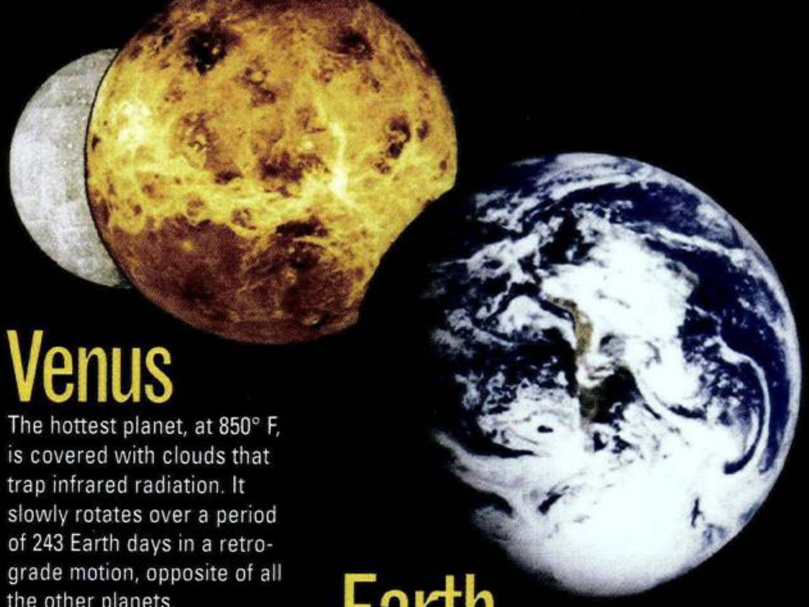
- EASY TO USE, PORTABLE - **NO COMPUTER REQUIRED**
- VIEW THE MOON, PLANETS **AND** DEEP SPACE OBJECTS ON ANY VIDEO MONITOR OR ON THE OPTIONAL BUILT-IN 5″ LCD DISPLAY
- RECORD VIDEO IMAGES ON ANY VCR ◆ NO FRAME GRABBER REQUIRED
- STORE DIGITAL IMAGES IN THE STV's INTERNAL MEMORY FOR DIRECT DOWNLOAD TO A COMPUTER AT A LATER TIME
- OPERATES AS A STAND ALONE AUTOGUIDER, 30 TIMES AS SENSITIVE AS A ST-4
- REACH 14th MAGNITUDE IN ONE SECOND (18th MAGNITUDE IN ONE MINUTE) THROUGH AN 8″ SCOPE

SBIG
ASTRONOMICAL
INSTRUMENTS

SANTA BARBARA INSTRUMENT GROUP
147-A Castilian Drive
Santa Barbara, CA 93117
Phone (805) 571-7244 FAX (805) 571-1147
e-mail: sbig@sbig.com Home address: www.sbig.com

Home Sweet Spheres

Our Solar System's prime-time players range from rocky to gassy and icy to hellish. *Text by Samantha Beres; NASA photos*



Mercury

The first planet is just 36 million miles from the sun and has a year equal to 88 Earth days. The temperature varies from 870° F to –300° F depending on what area is in sunlight or shade.

Venus

The hottest planet, at 850° F, is covered with clouds that trap infrared radiation. It slowly rotates over a period of 243 Earth days in a retrograde motion, opposite of all the other planets.

Earth

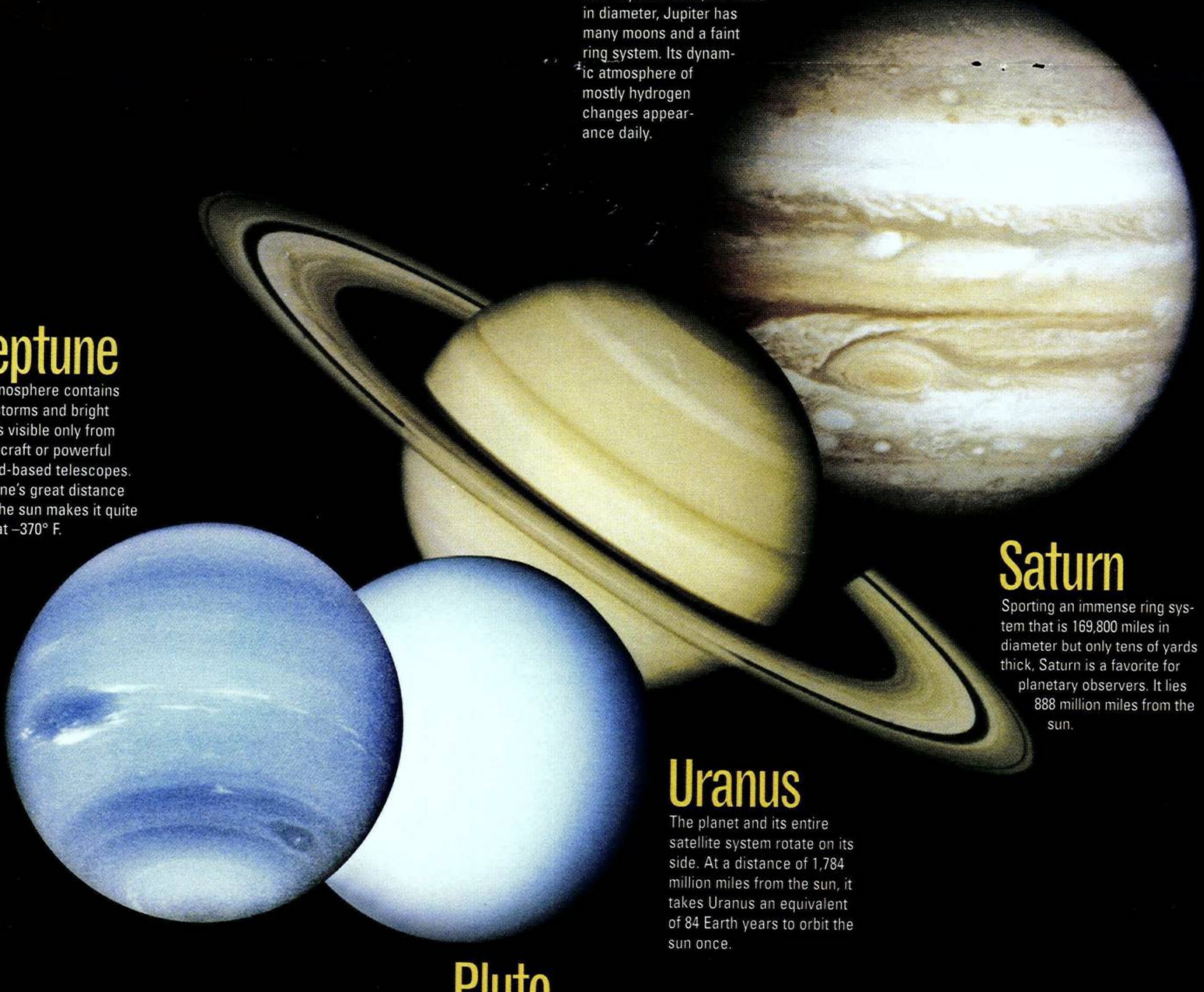
The average temperature on Earth is 45° F. With a diameter of 7,926 miles, it is the largest of the terrestrial planets. Earth also has the largest satellite of any of the inner planets.

Earth's Moon

The moon probably formed after a Mars-sized object collided with Earth. Its old, cratered surface allows us a peek into the past history of the solar system. The moon is the only body besides Earth that man has ever set foot on.

Mars

The fourth planet is similar to Earth, with a rotation similar in length to an Earth day and seasons that are caused by changes in sunlight falling on the different hemispheres. Mars has two small moons.



Jupiter

The largest planet in the solar system at 88,846 miles in diameter, Jupiter has many moons and a faint ring system. Its dynamic atmosphere of mostly hydrogen changes appearance daily.

Saturn

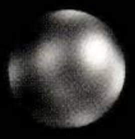
Sporting an immense ring system that is 169,800 miles in diameter but only tens of yards thick, Saturn is a favorite for planetary observers. It lies 888 million miles from the sun.

Neptune

Its atmosphere contains dark storms and bright clouds visible only from spacecraft or powerful ground-based telescopes. Neptune's great distance from the sun makes it quite cold, at –370° F.

Uranus

The planet and its entire satellite system rotate on its side. At a distance of 1,784 million miles from the sun, it takes Uranus an equivalent of 84 Earth years to orbit the sun once.



Pluto

The smallest planet in the solar system with a diameter of 1,485 miles, Pluto may be just one representative of a large body of icy objects that orbit the sun at over 3,500 million miles out.

Astronomy.com

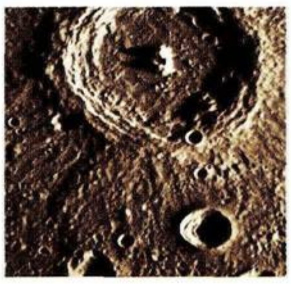
Astronomy

Mercury

Swift Mercury, which orbits the sun in just 88 days, remains a stranger to us. Though views of Mercury captured during a 1970s space mission suggested a planet with an inactive, moonlike surface, those same pictures have only recently unveiled a more dynamic history. A recent resurrection of data from three Mariner 10 flybys (1974–1975) reveals a surface shaped by volcanism as well as numerous impacts. Old lava flows and quake faults pepper Mercury's crust.

Mark Robinson of Northwestern University has been reanalyzing Mariner 10 data. Color images reveal the flow patterns of volcanic eruptions in many regions. Lava spread to form smooth plains and rilles (channels or collapsed lava tubes) within the plains of some craters. In other areas, the images show clear signs of impact craters.

While unlocking the secrets of decades-old data might be challenging, Robinson looks forward to results from Messenger, a mission to orbit Mercury in 2004. Messenger has a big job of answering the many questions that still remain.

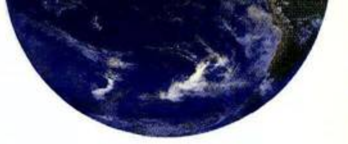


Venus

During the past 40 years, the major technology astronomers have used to see the surface of Venus through its thick cloud cover has been radar. Gradual improvements in radio telescopes revealed a surface covered with volcanoes. More surprising, though, was the realization that none of the surface features could be more than about 500 million years old, a fortnight in geologic time. The heavy weight of evidence suggests that volcanic eruptions have resurfaced the whole of Venus during a brief, catastrophic event.

New tools are unlocking more about the surface and atmosphere. Infrared Earth-based telescopes can cut through the dense clouds that surround the hottest planet — but only periodically every 19 months. When Venus passes between Earth and the sun, telescopes can collect data through spectral windows in the clouds.

The dense atmosphere produces an effective greenhouse; some sunlight gets to the surface, but infrared radiation coming from the ground is trapped by gases, raising surface temperatures to a scorching 900° F.



Earth

Our home planet, 93 million miles from the sun, is currently being seen by a specialist. The satellite Terra, launched in December 1999, orbits Earth and uses remote sensing to simultaneously study Earth's clouds, water vapor, small particles in the atmosphere, trace gases, and land and oceanic properties. Terra will help refine our understanding of how these interact and affect Earth's energy and climate.

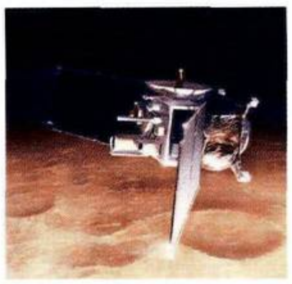
Terra is part of a 15-year-long project that will give scientists all over the world an opportunity to watch changes on Earth and to determine how the changes occur. Earth, well-studied as it is, keeps some secrets from scientists that have been more easily revealed on the other inner planets.

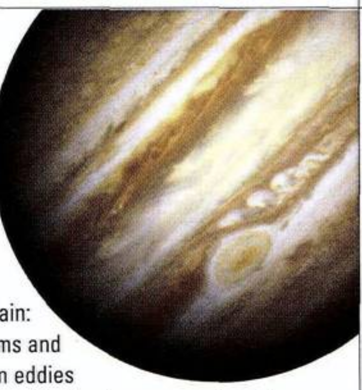
The terrestrial planets of Mercury, Venus, Mars, and even the moon generally show more scars from impacts during the violent evolution of the solar system. Earth does not, as erosion and continental drift have erased much of our planet's geological history. Our most elderly rocks are perhaps 4 billion years old, but most of planet Earth's exterior is 100 million years old.

Mars

Human fascination with Mars has always depended somewhat on the hope that life resides there. Until the powerful telescopes of the mid-20th century emerged, some observers believed they saw signs of civilization in the linear markings on the martian surface. In the 1960s, NASA Mariner fly-bys imaged an apparently lifeless, moonlike surface. Then in 1971, NASA put Mariner 9 into orbit around Mars. Later other craft delivered landers to the surface that sent back no signs of life. During the 1990s, martian meteorites, the Mars Pathfinder mission, and Mars Global Surveyor began to refine our search for water on the Red Planet.

The latest data from Mars Global Surveyor show evidence of a northern ocean on the Red Planet. "We're finding more and more evidence for a warmer and wetter early period on Mars," says Matt Golombek of the Jet Propulsion Lab. "There's evidence that an ocean filled the northern plains once." The martian environment is so appealing to researchers because it seems to be the most like Earth.





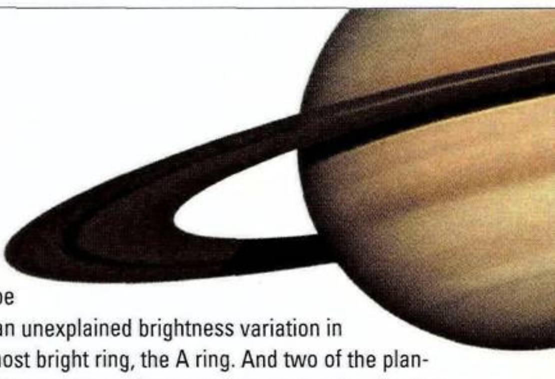
Jupiter

Weather on Jupiter could be compared to a food chain: At the top, enormous storms and winds feed on energy from eddies below. A recent discovery by Galileo images points to thunderstorms that likewise drive the eddies.

"Voyager showed us lightning on the night side of Jupiter — an indicator of powerful updrafts and release of latent heat that supply energy for the eddies, but we couldn't link it up with the day side," says Andrew Ingersoll of Caltech. Galileo pictures portray a day side with the familiar cloud features of a thunderstorm, then a couple of hours later, the night side of the same territory with flashes of lightning. In effect, the images link the lightning to its source.

The discovery of these thunderstorms should help scientists build more precise numerical models of the weather patterns on Jupiter.

Galileo first viewed Jupiter's four large moons through a telescope. Today we know of 17 moons, but only the largest are targets of NASA's spacecraft for ongoing research.

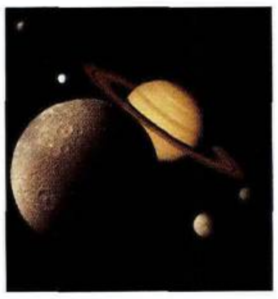


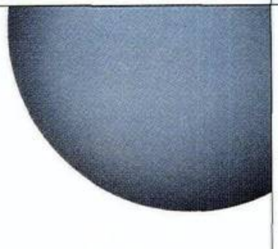
Saturn

New Hubble Space Telescope pictures show an unexplained brightness variation in Saturn's outermost bright ring, the A ring. And two of the planet's moons — the ones that scientists think may be "herding" an internal ring — have unexplained, erratic orbits.

"Prometheus and Pandora, the two shepherd satellites in Saturn's F ring, have screwy orbits that are changing before our eyes," says Richard French of Wellesley College. "Each time we look at the satellites they're getting bumped around by something and we don't know what it is."

While Hubble will continue to take detailed pictures of the rings, the Cassini spacecraft is en route to Saturn, due to arrive in 2004. It will orbit Saturn for several years, gathering information on the storms, rings, and satellites. Upon reaching Saturn, Cassini will launch the Huygens probe to explore Saturn's moon Titan. Titan has shown evidence for water ice in the past, and Huygens will scrutinize its clouds, atmosphere, and surface for signs of the compound.





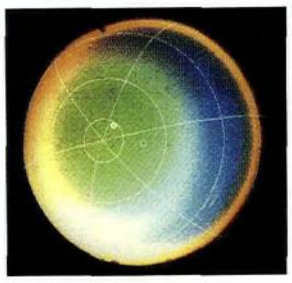
Uranus

The third of the four gas giants, Uranus has the brightest clouds in the solar system. As time goes on, the planet continues to reveal new cloud features never seen before.

"What's interesting is that the clouds' hemispheres don't seem to be symmetrical," says Erich Karkoschka of the University of Arizona. "A big difference exists between north and south and in the brightness and color. At the moment it's not clear if that's intrinsic or a change that comes with the seasons."

Because a year on Uranus lasts 84 Earth years and the blue-green planet rotates on its side, planetary scientists have not seen the portion now coming into view since the 1960s. As Uranus's dark hemisphere appears, high northern latitudes will be seen as if for the first time.

Uranus must have suffered a major collision with a huge object; it is tipped on its side, compared with the other planets. Uranus's equator runs perpendicular to its orbit around the sun. The rotational and orbital axes are nearly aligned; therefore, we see Uranus pole-on every 42 years.

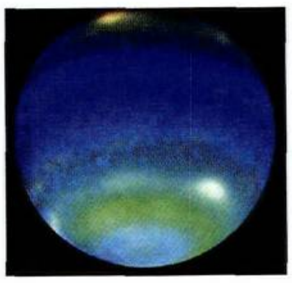


Neptune

Neptune is now being seen like never before. Cornell researchers have built an infrared camera that provides detailed images of the planet that are unaffected by atmospheric turbulence. Built for the 200-inch Hale Telescope at Palomar Mountain Observatory, the Palomar High Angular Resolution Observer, coupled with a new adaptive optics system, can provide high spatial resolution simultaneously with spectral information, giving fine details of Neptune.

New images show a massive cloud on Neptune about the size of Europe, as well as numerous smaller clouds. Scientists should soon be able to determine the compositions and altitudes of the clouds as well as learn more about the planet's atmospheric circulation.

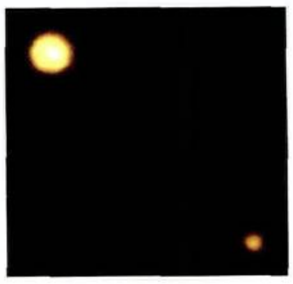
Neptune also sits in the middle of a system of dark rings and eight identified moons. Its largest moon, Triton, orbits Neptune clockwise, opposite the orbits of all the planets around the sun and all the major moons around their planets. Almost everything else moves in a counterclockwise pattern, to which Triton rebels.



Pluto

The Hubble Space Telescope has taken several close looks at the ninth planet, Pluto, and its giant moon, Charon. The surface of Charon is covered in water ice, according to Mark Buie of Lowell Observatory. A detailed spectrum of Pluto, currently being analyzed, will probably show methane, nitrogen, carbon monoxide, and water ice on the planet's surface. "We are trying to untangle the distribution and understand it relative to the visible maps," says Buie.

Pluto is the only planet in the solar system with a satellite close to its own size and brightness, leading some astronomers to think of the two as a double planet. Although the sizes are not known exactly, Charon is probably 780 miles in diameter, and Pluto 1,430 miles in diameter. Pluto is so distant that scientists have no accurate idea about its surface features. We do know it has an elliptical orbit around the sun, alternating between 2.8 billion miles and 4.6 billion miles distant. About every 250 years, Pluto's orbit takes it inside the orbit of Neptune, making it the eighth planet for 20 years at a time.



ASTROPTX
WHOLESALE OPTICS
Celestron ★ Meade ★ B&L
Telescopes-Binoculars-Accessories

LOWEST PRICES
Tel: (860) 355-3132
INVENTORY SALE

9am to 9pm (7) Days
Fax: (203) 746-3579 (24) Hrs
57 North Street #401
Danbury, CT 06810
Huge Discount Catalog
5,000 Items $10 (refundable)

DISCOVER
MasterCard
VISA

E-MAIL: ASTROPTX@ASTROPTX.COM
WWW.ASTROPTX.COM

Astronomy
Northern Lights Tour

Alaska:
March 17-26, 2001

For more information call
Specialty Tours today at:
1-800-677-9412 (US only)
or 727-796-7555
www.alspecialtytours.com
Space is limited – don't delay!

JOIN
Astronomy

Chase the colorful curtains of the aurora borealis through Alaska's interior with *Astronomy* Magazine. Along with catching one of the most spectacular views of the night sky, you will experience the magnificent vistas of a great, unspoiled wilderness.

Our experience begins with five nights in Fairbanks, one of Alaska's major urban centers that still maintains a pioneering spirit. You can arrange to shop, downhill ski, attend the Ice Festival, or simply curl up with a good book.

The adventure continues in Chena Hot Springs, 60 miles from Fairbanks, and far from light pollution. The evening aurora should produce an impressive show as solar activity is expected to be high in March 2001. During the day, you can take advantage of cross-country skiing, snow shoeing, and ice-skating. Or relax in the world-famous hot springs.

The breathtaking scenery is guaranteed to put you on sensory overload. Whatever your choices for the daylight and evening hours, pack your warm clothes and join *Astronomy* on this watch for the magical northern lights in the heart of Alaska. See you there!

SOLAR FILTERS

We offer a full line of full aperture and off/axis solar filters made from the famous BAADER AstroSolar film.This filter offers unsurpassed resolution and image quality. Photographic film available upon request.

TV Ranger	$45
TV Pronto	$45
C80	$50
ETX 90	$55
C102	$60
Questar 3.5	$63
AP 105	$65
TV 101/102	$65
C5/ETX 125	$68
AP 130	$70
AP 155	$75
8" SCT	$85
C9.25	$110
10" SCT	$120
C11 F/A	$135
C11 O/A	$85
12" SCT F/A	$150
12" SCT O/A	$95
C14 F/A	$185
C14 O/A	$105

Other sizes available

H-ALPHA FILTERS

We carry the full line of Coronado Instruments H-alpha filters and scopes. Call for pricing or visit our web site for details.

SUN FINDER

Unique tool for fast and easy centering of the sun in your eyepiece. Fits over your Telrad or any telescope tube up to 6" in diameter.

BUY DIRECT OR FROM YOUR FAVOURITE DEALER

POWER PACKS

12V 18 AMP HOUR
Comes with float charger, carry bag, built in fused cigarette lighter power socket. **$125.00**

NEW!!! NEW!!! NEW!!! NEW!!!
18 AMP HOUR DUAL PLUG POWER PACK
2 fused plugs, Digital meter, .750 amp float charger, carry bag. Comes in two configurations, 12volt & 18 volt

18 volt..$245
12 volt..$175

33 AMP HOUR BATTERY
SAME AS 18 AMP HOUR BUT WITH 4 PLUGS AND MORE POWER! Comes in two configurations, 12 volt & 18 volt.

18 volt version is for LX 200 owners.
One plug has a built in inverter for 18 volt output.

12 volt..$290

18 volt..$390

OBSERVING CHAIR

ULTIMATE II

Ultimate II has a folding accessory tray for eyepieces filters, charts etc.

Made from Baltic Birch Plywood.

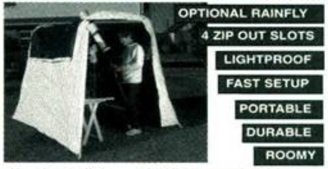
ULTIMATE

OBSERVER TENT

ZIP OUT ROOF
EASY SETUP
PORTABLE
DURABLE
RAINFLY
ROOMY

Has two rooms. One for sleeping, another for your scope. This is a **BIG TENT.** The floor dimensions are 15' x 9' x 6' 6" (center height). Packs down to 45" x 8" x 8". Weight is 30 lbs.

SHELTER-DOME



Absolutely lightproof. White exterior, black interior. Interior floor dimensions are 10' x 7'. Packs down to 56" x 20" x 8". Weighs 30 lb

SKY TENT

Unique portable observatory with a rotating dome. Set up in 30 minutes. Weatherproof, semi permanent. Various sizes and options. Call for pricing.

DEW REMOVERS

The world's best system for truly effective dew and frost control. Available for almost all optics used in amateur astronomy today. Thousands of systems sold.

controller	$70.00
.965"	$33.00
1.25"	$35.00
2"	$38.00
3"	$40.00
4"	$43.00
5"	$45.00
6"	$48.00
7/8"	$50.00
9/10"	$60.00
11"	$65.00
12"	$70.00
14/16"	$80.00
Telrad heater	$23.00
Telescope computer control heater	$35.00

DEW CAPS

Flexible, Felt lined, Durable. Save up to 85% vs Brand Name.

LASER COLLIMATORS

Laser collimators for SCTs, Newtonians, Mak Newts, Ritchey Chretiens, Mak Cass.

SCT laser	$175
SCT NGF-S	$190
2" Laser	$110
1.25" Laser	$100

KWIK FOCUS

A unique and easy to use focusing aid for observers, astrophotographers and CCDers. Get excellent results with little effort. Available for most commonly used amateur telescopes. $30 to $65.

KENDRICK ASTRO INSTRUMENTS
2920 Dundas St. W., Toronto, ON M6P 1Y8, CANADA
TOLL FREE 1 800 393 5456 - PH 416 762 7946 - FAX 416 762 2765
ORDER ONLINE @ www.kendrick-ai.com email to: info@kendrick-ai.com

sky Show

march

Brilliant Venus plunges from view, while Jupiter and Saturn keep night owls company.

by Martin Ratcliffe and Alister Ling

▶ Our sister planet, Venus, is passing through a lot of phases. Aim your scope on this target to see a 20-percent lit crescent thin to a sliver late in the month. Because Venus is also rounding the inside curve of its orbital racetrack, the planet is much closer to us and noticeably bigger than it often appears. If you take precautions to guard against solar rays when Venus passes north of the sun in the daytime sky, you just might see the horns of Venus stretch all the way around to encircle the planet in a ring of light.

Fantastic is hardly enough to describe the great conjunctions, or groupings, between the moon and the gas giants Jupiter and Saturn. On the 1st and 29th the moon hangs between Jupiter and the sprawling Hyades star cluster. These two nights offer good opportunities to hold a public stargaze or set up your own sidewalk astronomy party; you'll be much appreciated.

Would you like to see a star move in one year? The components of the triple star system Zeta (ζ) Cancri are now practically in a line, but by this time next year, the stars will have noticeably moved. All you need to see this is an 8-inch scope and a steady night.

While you're out in the darkness of the countryside this month, either checking out the "UFO Galaxy" or a couple of asteroids, keep an eye on the sky for shooting stars. Four minor meteor showers reach their peak near new moon, meaning that you have a good chance of spotting swift streaks. Even if you're not a die-hard meteor observer, there's something undeniably pretty about them.

Mars, named after the Roman God of War, or his Greek counterpart Ares, will soon dominate the evening skies of summer. Until it does, you can find Mars rising in the east after midnight. The Red Planet is growing slightly larger as it approaches opposition and will show more and more in telescopic views. Compare it to its stellar rival Antares, the heart of the Scorpion. Is Mars really red? What color do you see? The moon joins the duel on the 15th.

Jupiter (left) and Saturn float among the stars of the Hyades and Pleiades on September 27, 2000. Herman M. Heyn

2001 March

1 The moon passes 2° south of Saturn, 1 P.M. EST

2 The moon passes 3° south of Jupiter, 4 A.M. EST
First quarter moon is at 9:03 P.M. EST

4 Mars passes 5° north of Antares, 9 A.M. EST

7 Venus is stationary, 6 A.M. EST

8 The moon is at perigee (223,554 miles from Earth), 3:55 A.M. EST

9 Full moon is at 12:23 P.M. EST

10 Mercury passes 0.1° north of Uranus, 6 A.M. EST
Asteroid Eleonora is at opposition, 9 A.M. EST (page 73)

11 Mercury is at greatest western elongation (27°), 1 A.M. EST (page 71)

15 The moon passes 1.8° north of Mars, 4 P.M. EST (page 71)

16 Last quarter moon is at 3:45 P.M. EST

18 The moon passes 0.5° north of Ceres, 2 A.M. EST

20 The moon passes 2° south of Neptune, 3 A.M. EST
The moon is at apogee (251,950 miles from Earth), 6:25 A.M. EST
Vernal equinox is at 8:31 A.M. EST

21 The moon passes 3° south of Uranus, 9 A.M. EST

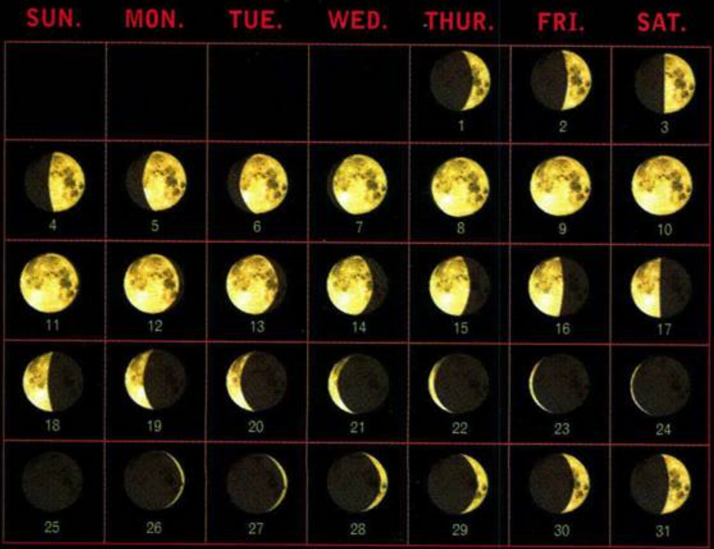
22 The moon passes 2° south of Mercury, 1 P.M. EST

24 New moon is at 8:21 P.M. EST

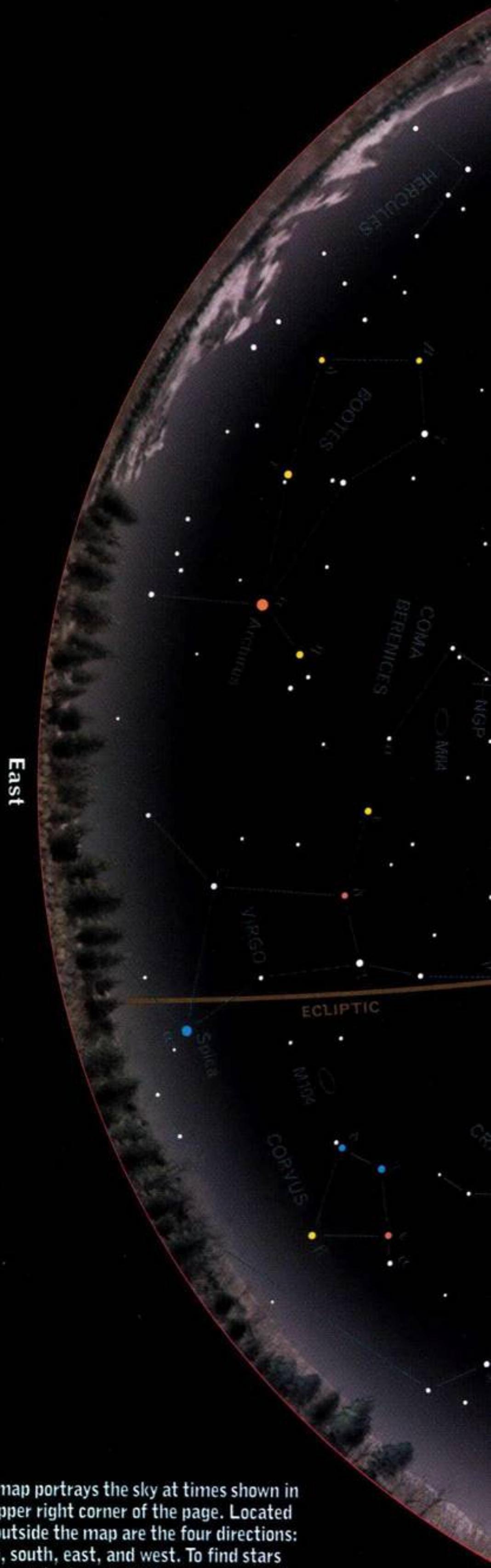
27 Asteroid Vesta is in conjunction with the sun, 2 A.M. EST

28 The moon passes 1.7° south of Saturn, 11 P.M. EST (page 71)

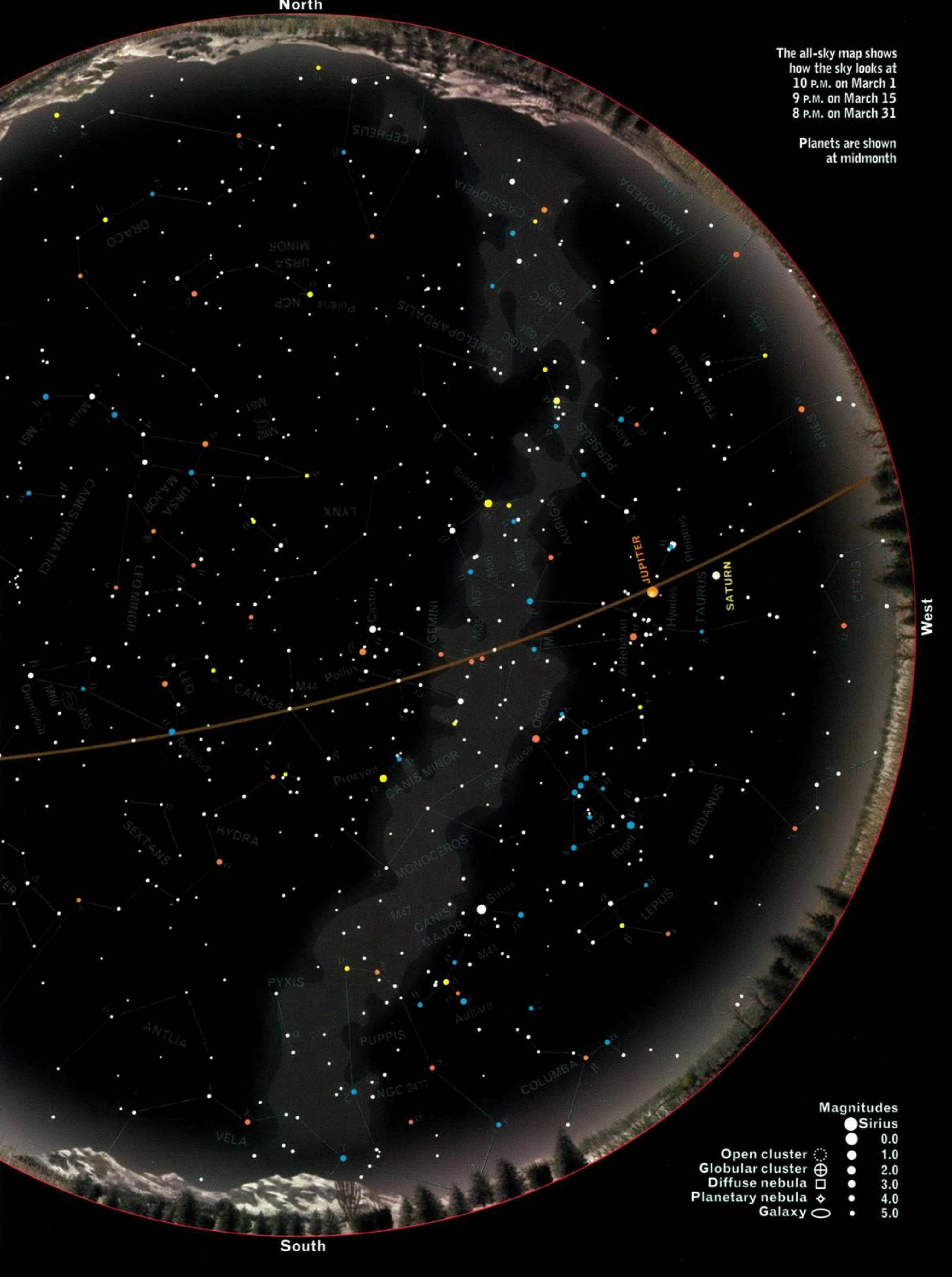
29 The moon passes 2° south of Jupiter, 4 P.M. EST
Venus is in inferior conjunction, 11 P.M. EST



SUN.	MON.	TUE.	WED.	THUR.	FRI.	SAT.
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31



This map portrays the sky at times shown in the upper right corner of the page. Located just outside the map are the four directions: north, south, east, and west. To find stars above your horizon, hold the map overhead and orient it so a direction label matches the direction you're facing. The stars above the map's horizon now match what's in the sky.

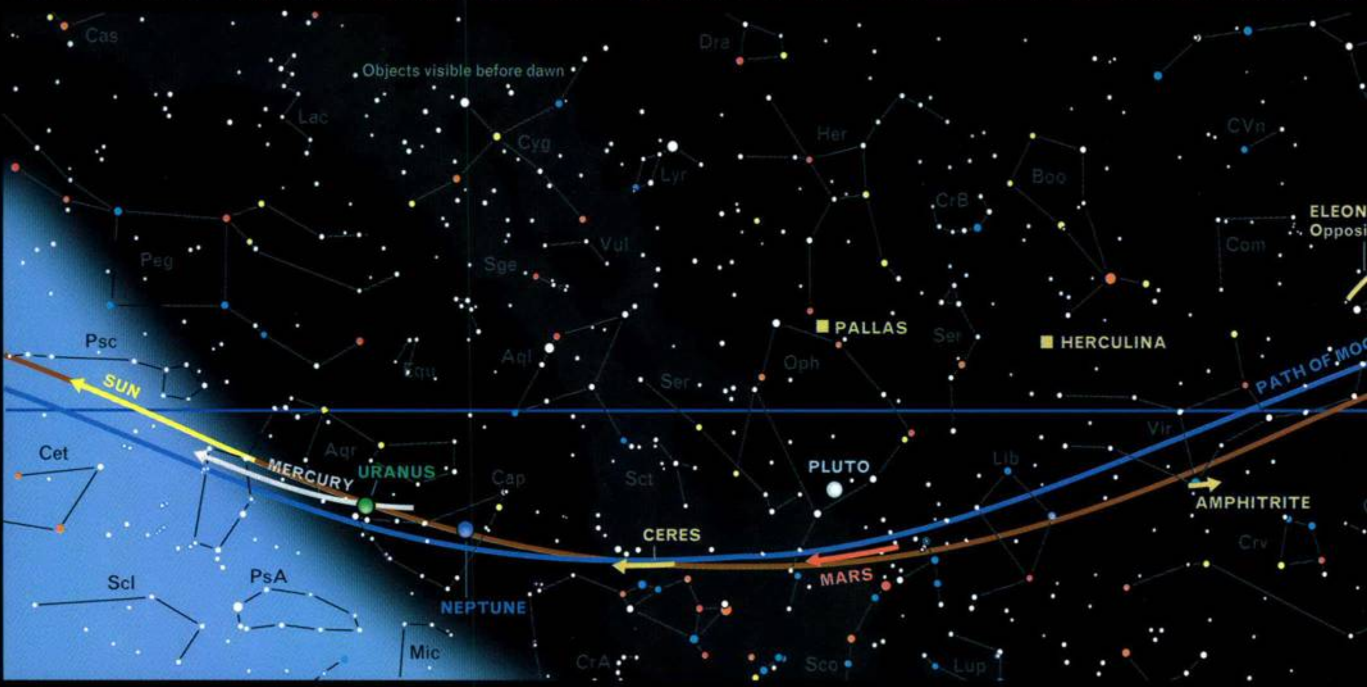

North
South
West
CEPHEUS
CASSIOPEIA
ANDROMEDA
DRACO
URSA MINOR
Polaris
NCP
CAMELOPARDALIS
NGC 869
NGC 884
TRIANGULUM
M33
ARIES
PERSEUS
Algol
Mizar
M51
M81
M82
URSA MAJOR
CANES VENATICI
LYNX
Capella
AURIGA
Pleiades
JUPITER
SATURN
TAURUS
Hyades
Aldebaran
CETUS
LEO MINOR
M36
M38
M37
M35
GEMINI
Castor
Pollux
M44
CANCER
LEO
Denebola
M66
M65
Regulus
ORION
Betelgeuse
Procyon
CANIS MINOR
HYDRA
SEXTANS
M42
Rigel
ERIDANUS
MONOCEROS
Sirius
M47
CANIS MAJOR
M41
LEPUS
PYXIS
Adhara
ANTLIA
PUPPIS
NGC 2477
COLUMBA
VELA
Magnitudes
Sirius
0.0
1.0
2.0
3.0
4.0
5.0
Open cluster
Globular cluster
Diffuse nebula
Planetary nebula
Galaxy

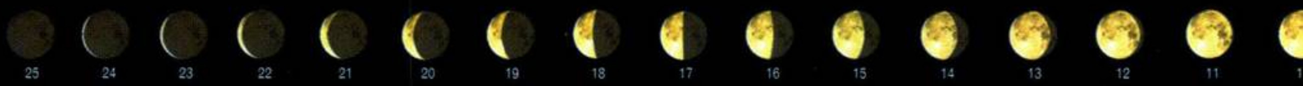
The all-sky map shows
how the sky looks at
10 P.M. on March 1
9 P.M. on March 15
8 P.M. on March 31

Planets are shown
at midmonth

Path of the Planets

This map unfolds the entire night sky from evening (at right) until sunrise (at left). Arrows and squares show the movements and locations of solar system object


Cas
Objects visible before dawn
Dra
Lac
Cyg
Her
Lyr
CVn
Boo
CrB
ELEON
Opposi
Peg
Vul
Com
Sge
PALLAS
Ser
HERCULINA
Psc
SUN
Equ
Aql
Oph
Ser
PATH OF MO
Vir
Cet
Aqr
MERCURY
URANUS
Cap
Sct
PLUTO
Lib
AMPHITRITE
CERES
Crv
MARS
Scl
PsA
NEPTUNE
Mic
CrA
Sco
Lup

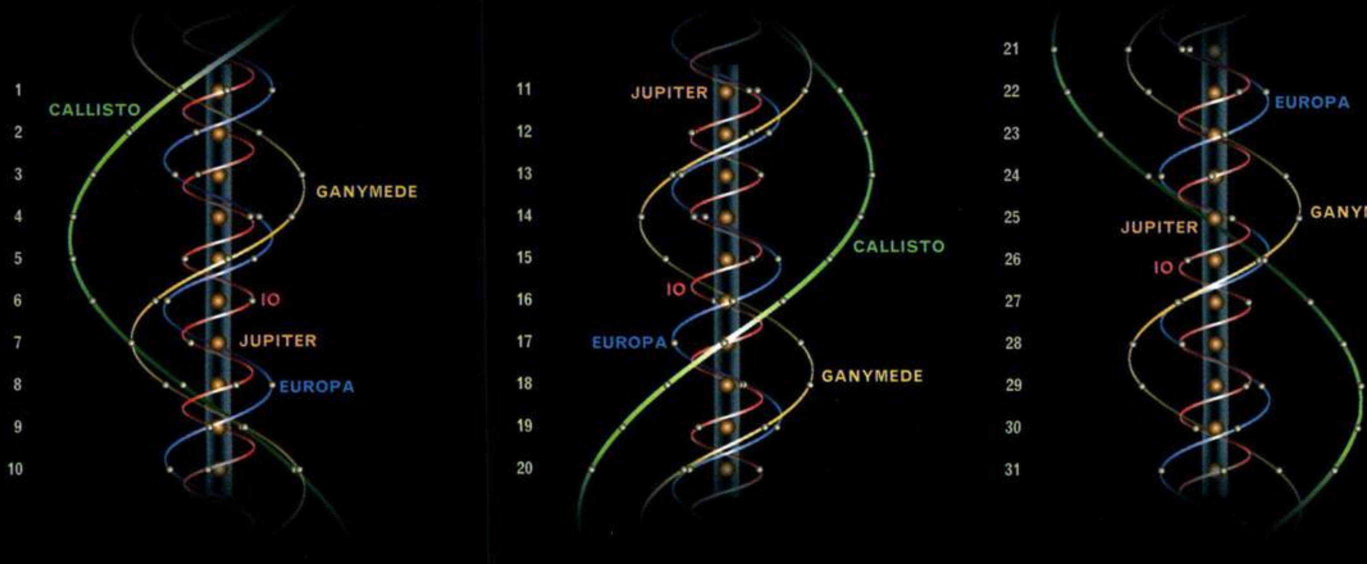

25
24
23
22
21
20
19
18
17
16
15
14
13
12
11

To locate the moon in the sky, draw a line from the phase

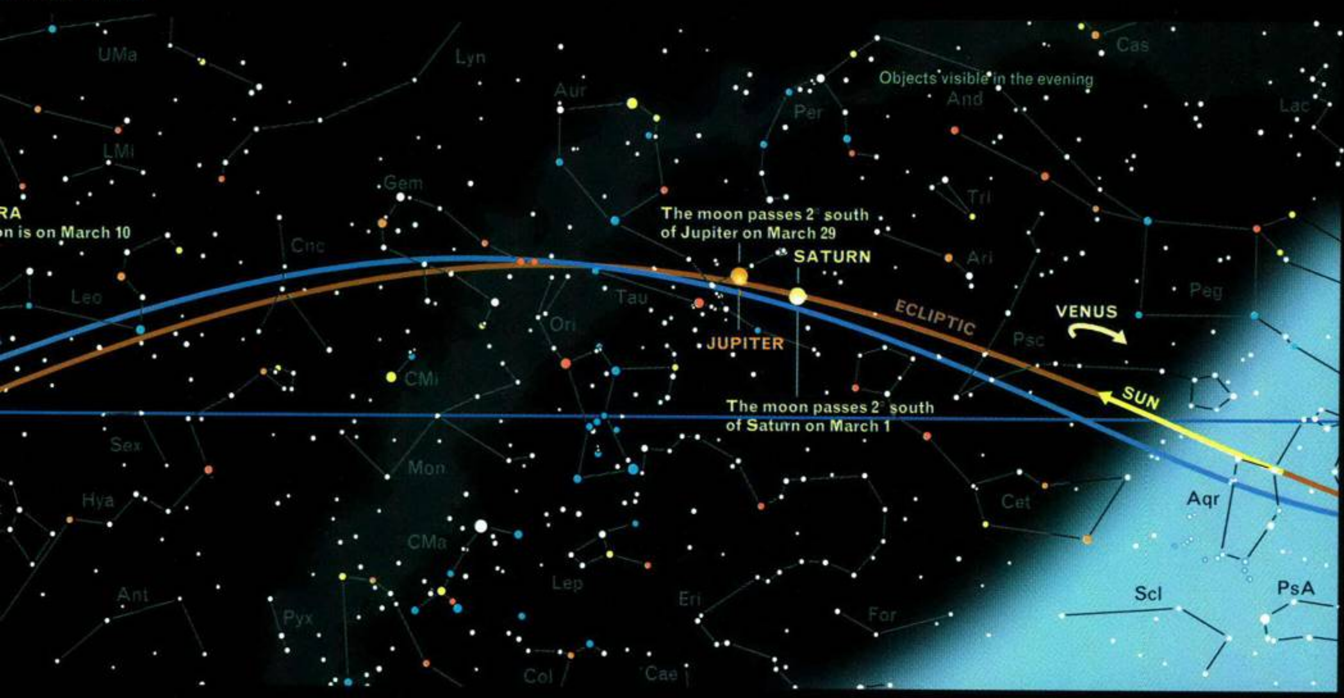
PLANETS	MERCURY	MERCURY	VENUS	VENUS
Date	March 1	March 31	March 1	March 15
Magnitude	0.6	−0.2	−4.6	−4.4
Angular Size	8.7"	5.6"	43.4"	53.3"
Illumination	36%	79%	21%	8%
Distance (AU) from Earth	0.778	1.193	0.385	0.313
Distance (AU) from Sun	0.429	0.442	0.719	0.719
Right Ascension (2000.0)	21h12.2m	23h25.2m	0h51.6m	0h50.3m
Declination (2000.0)	−14°49'	−6°21'	11°48'	13°53'

Jupiter's Moons

Dots display positions of Galilean satellites at 11 P.M. EST on date shown. South is at top to match the view in a telescope.



during the month.

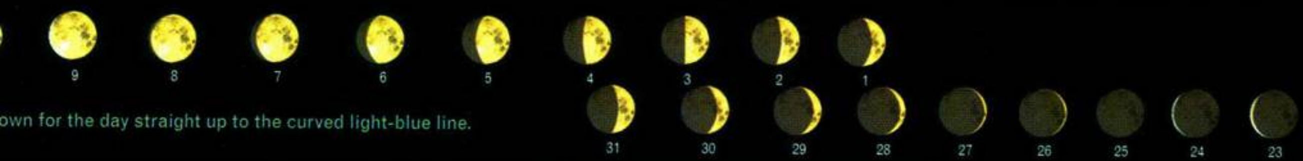

UMa
Lyn
Cas
And
Lac
LMi
Aur
Per
Gem
Tri
Cnc
Ari
Leo
Tau
Peg
Ori
Psc
CMi
Sex
Mon
Cet
Hya
Aqr
CMa
Ant
Lep
Eri
Scl
PsA
Pyx
For
Col
Cae
ECLIPTIC
VENUS
SUN
JUPITER
SATURN
RA

Objects visible in the evening

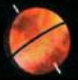
on is on March 10

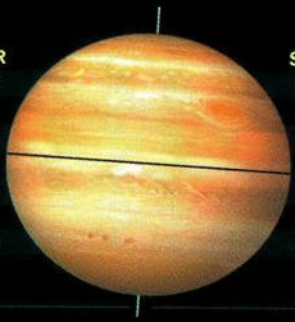
The moon passes 2° south of Jupiter on March 29

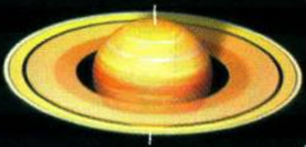
The moon passes 2° south of Saturn on March 1


9
8
7
6
5
4
3
2
1
31
30
29
28
27
26
25
24
23

own for the day straight up to the curved light-blue line.







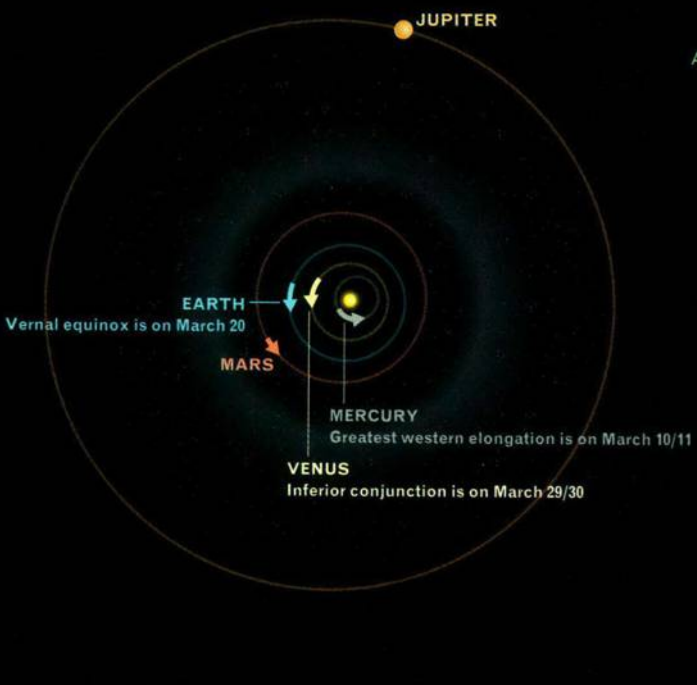
MARS	**JUPITER**	**SATURN**	**URANUS**	**NEPTUNE**	**PLUTO**
March 15	March 15	March 15	March 15	March 15	March 15
0.2	−2.2	0.2	5.9	8.0	13.8
8.8"	37.1"	17.4"	3.4"	2.2"	0.1"
89%	99%	100%	100%	100%	100%
1.063	5.314	9.530	20.803	30.781	30.189
1.585	5.069	9.102	19.964	30.105	30.361
16h49.8m	4h12.2m	3h37.3m	21h41.0m	20h41.1m	17h00.7m
−21°48'	20°36'	17°29'	−14°36'	−18°08'	−12°07'

DE

ALLISTO

The Planets in Their Orbits

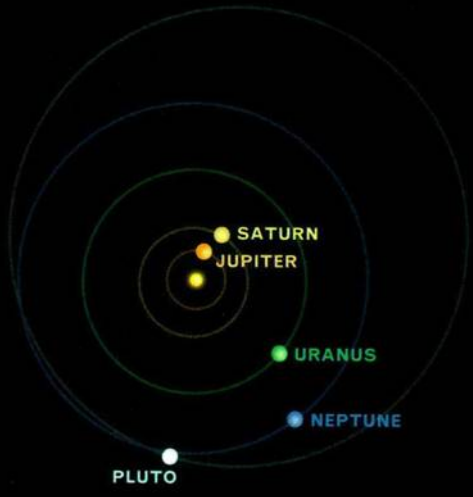
Arrows and dots show planets' positions during the month.


JUPITER
EARTH
MARS
MERCURY
VENUS

Vernal equinox is on March 20

Greatest western elongation is on March 10/11

Inferior conjunction is on March 29/30


SATURN
JUPITER
URANUS
NEPTUNE
PLUTO

Track a Star System's Movements

"Balderdash!" That was what the great British observer Sir William Herschel thought about stars orbiting each other. By making careful measurements of close double stars, he intended to convince other astronomers that the stars were simply in the same line of sight. As Herschel expected, unrelated stars did pass each other in straight lines, but to his surprise, several moved in the telltale arc of an orbit. The discovery of binary stars orbiting each other was the triumphant confirmation that Newton's theory of gravity was, indeed, universal.

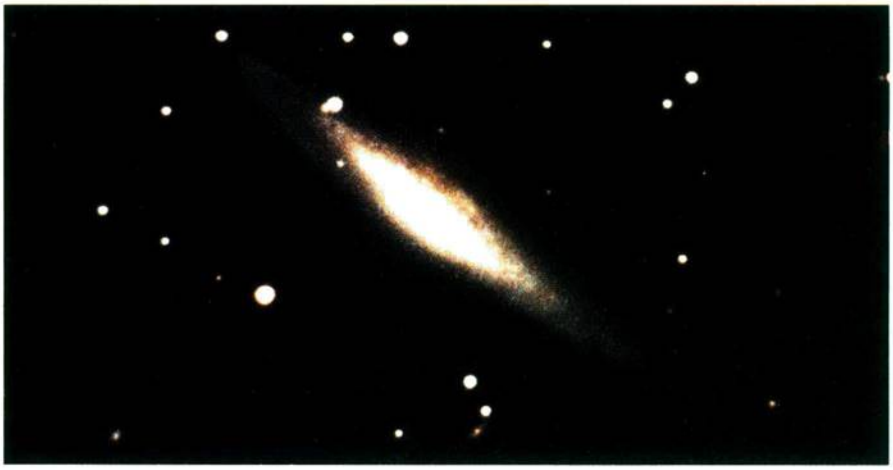
Zeta (ζ) Cancri is special for being a triple system. Right now the three stars practically form a straight line, and by next year they will be obviously different. In about another 65 years or so the inner star can swing around and catch up to the outer one again.

When you first sight Zeta Cnc in a telescope, you'll see a 5th-magnitude combined glow of the central pair with the outlying third component, at magnitude 6.2, off to the east and slightly north. If your scope has a drive and you turn if off, stars will enter the view from the east. The third component lies about 7" away. To put this separation in perspective, Jupiter's disk appears about 40" across.

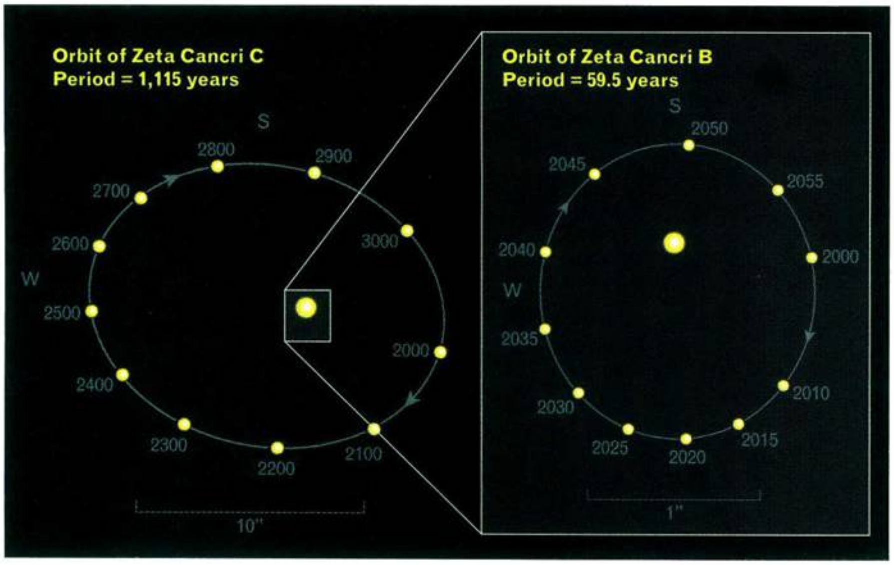
Splitting the inner sanctum of Zeta Cnc into two stars requires the resolving power of an 8-inch scope or perhaps a top-notch 5 incher. Only 0.8" from the primary, the 6th-magnitude B component will hide until you crank the magnification past 200x.

Chances are Earth's atmosphere is not behaving nicely, blurring the view with turbulence. You may need to try on several nights before you succeed. Make sure your scope is well aligned (collimated), and allow time for it to cool down in the night air.

Zeta Cnc is roughly 83 light-years away, which means that the inner components orbit each other at a distance of 25 AU (1 astronomical unit equals the Earth-sun distance, or 93 million miles). Imagine another bright star orbiting out between Uranus and Neptune in the solar system — wouldn't that be a curse on deep-sky observing?



NGC 2683 in Lynx, the "UFO" Galaxy, is bright enough to see in small scopes. Jason Ware



The orbital diagrams are adapted from Richard Dibon-Smith. Many more of his binary-star orbits can be found on the Internet at: http://www.dibonsmith.com/orbits.htm.

The "UFO" Galaxy

As if it were buzzing the top of Leo's head, the UFO Galaxy (NGC 2683) stands out as the brightest deep-sky object in the celestial cat Lynx. Located at right ascension 8h52.7m and declination 33°25', it's a nearly edge-on spiral of about 9' by 2' that boasts a 9th-magnitude visibility from urban backyards in a 10-inch scope. This will be much easier if you use a dark cloth to cover your head while at the eyepiece, so you can keep as much light pollution out as possible.

In larger scopes the bright central bulge begins to take on a mottled appearance. Under dark, rural skies, a 16-inch or larger telescope will reveal the dust lane that graces all edge-on spirals. A bright core above a dark lane and light spread out in a flat shape is all it took to trigger Astronaut Memorial Planetarium and Observatory staff to give the UFO Galaxy its nickname.

The UFO is receding from us at 410 km/s, which indicates that it is probably one of the nearby galaxies, perhaps at about 16 million light-years.

sky Show

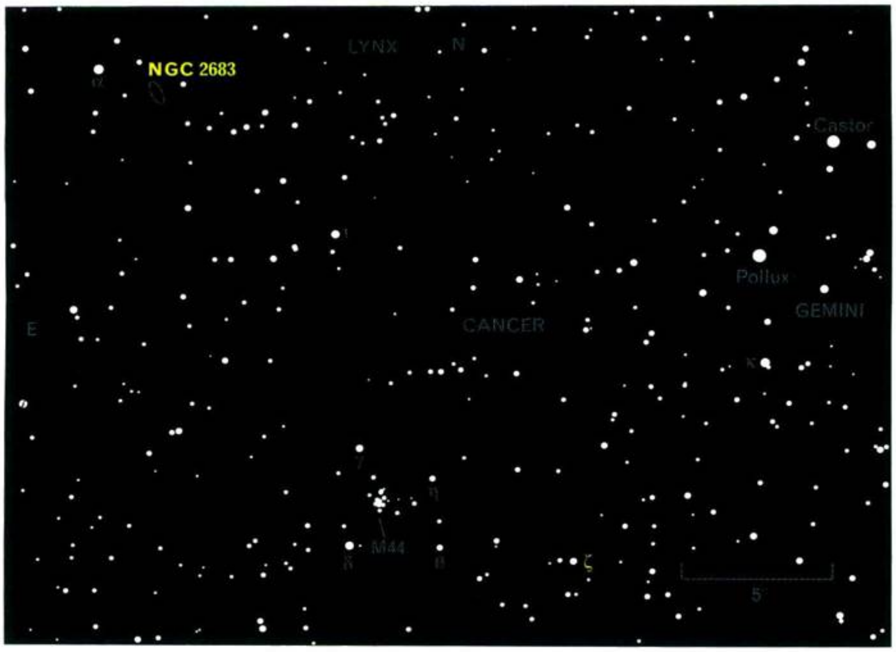
Three Bright Planets Rule the Night

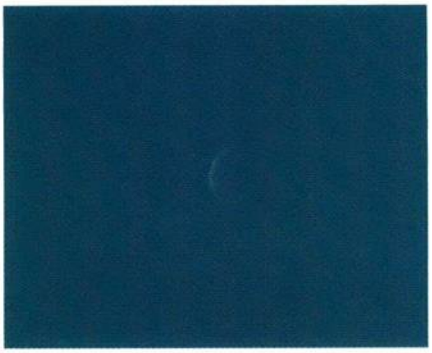
Venus, **Jupiter**, and **Saturn** dominate this month's planetary scene. Venus can only be viewed for a short period after sunset, but the two giant planets remain on view until midnight. March opens with the trio spanning 46° of sky after dusk. Venus shines with a stunning brilliance at magnitude –4.6 and sets three hours after the sun. High above Venus, Saturn and Jupiter continue to dominate the constellation Taurus the Bull. Heralding the appearance of the pair of planets is a near first-quarter moon that stands 4° east of Saturn on March 1.

Venus moves rapidly relative to the sun as it heads for its March 30 inferior conjunction. Consequently, Venus will quickly disappear from the evening sky. Watch the western sky at the same time each night during March to see Venus fall in altitude.

Only two planets in our solar system ever pass through inferior conjunction, that is, move directly between Earth and the sun. The two planets are Mercury and Venus. Due to their orbital tilt with respect to Earth, they rarely pass across the face of the sun, but observers have a rare treat coming up in a few years: long-awaited Venus transits arrive in 2004 and 2008.

Following Venus through a telescope this month reveals dramatic changes with the planet. On March 1, 20 percent of its globe gets illumination from the sun — making a fine crescent spanning 44". A mere 10 days later, the phase has shrunk to 10 percent and sets only two hours after the sun. By March 23, Venus sets an hour after sunset and is a tiny 2-percent illuminated slim crescent, yet is nearly 1' across. Tracking Venus to this point will be tricky due to its low altitude, although its magnitude remains above –4. You can try to spot Venus in daylight. Following its passage through conjunction, Venus will appear in the morning sky in April.





Venus is one of the few astronomical objects bright enough to see in daylight. Mark Payne-Gill

Saturn can be spotted standing high in the southwest as soon as the sky gets dark. The Ringed Planet lies only 6° south of the fine star cluster, the Pleiades, in Taurus the Bull. Saturn shines at magnitude 0.2. Although it's rather faint when compared with Venus and Jupiter, Saturn wins hands-down for beauty when viewed through a telescope. During the past few years our view of the southern face of the rings has been improving, and they now tilt 25°. The rings do tend to distract from the planet itself, although details on the saturnian disk are notoriously difficult to follow. Saturn's entire globe maintains a high-altitude haze that makes the dynamic features at lower altitudes quite subtle. If the planet reveals few details, then tracking Saturn's moons may be of more interest.

Last year, the discovery of four new moons gave Saturn a total of 22, surpassing the 21 orbiting Uranus, the previous leader in the number of satellites in its tow. You can track the brighter saturnian satellites. Four of them glow at 10th magnitude or more — Tethys, Dione, Rhea, and Titan — all easily visible through a 6-inch scope.

Jupiter has faded a few tenths of a magnitude since the beginning of the year, yet remains the brightest planet in the night sky after Venus, shining at magnitude –2.2. It also presents the most dynamic atmospheric features visible on any planet — a gold mine for beginners and veteran observers alike.

Jupiter doesn't rotate as a solid object — the region around the equator (called System I) takes 9 hours and 50 minutes, and the other portions on the planet (System II) take 9 hours and 55 minutes. The Great Red Spot lies just south of the South Equatorial Belt, placing it barely inside the System II rotation region. The difference in rotation speed stirs up the atmosphere — observers can time the passage of features across the central meridian (an imaginary line bisecting the planet north-south) and use planetary tables (such as in the *Astronomical Almanac* or *Observer's Handbook*) to calculate the longitude of each feature. They are known to drift in longitude. The Great

Red Spot has moved more than 8° since October 1999.

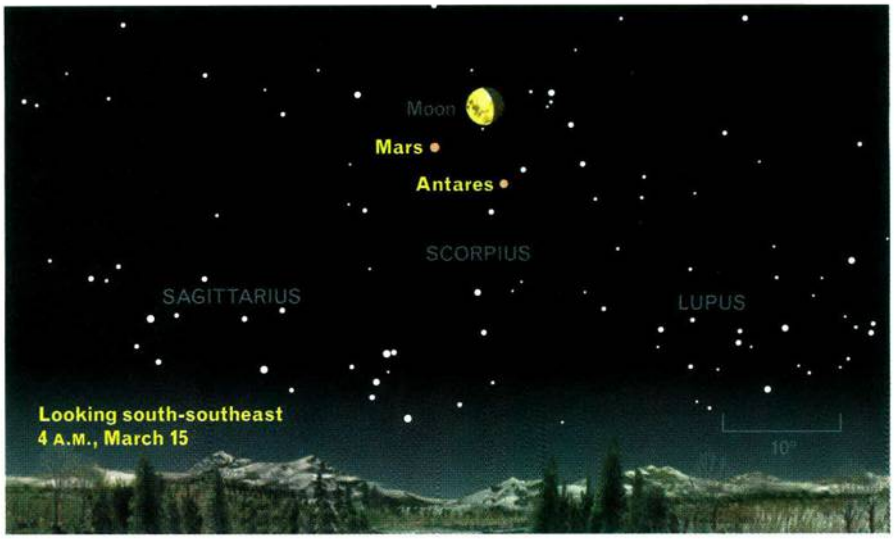
The moon passes the giant planets twice this month; once on March 1 in its first quarter phase, and again at the end of the month. On March 28, a fine crescent lies 4° southwest of Saturn. On the following night, it passes less than 3° southeast of Jupiter. Be sure to check out these rare opportunities.

Mars rises in the southeast shortly after 1 A.M. in early March. It lies in the constellation Ophiuchus the Serpent Bearer, where it will remain for the entire month. Just 5° south of Mars is Antares, the brightest star in Scorpius the Scorpion. This month their relative proximity shows how similar the two appear. Their colors closely match — however, this is due to two different processes. Mars is reflecting sunlight off its red soil, while Antares, as a star, emits its own light, and its color indicates its surface temperature.

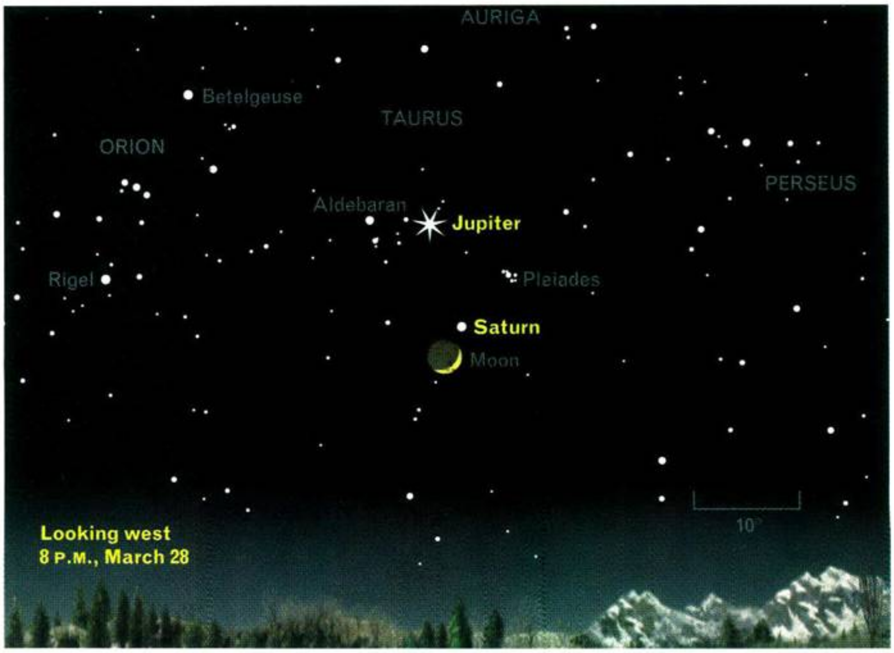
By the end of March, Mars rises at 12:30 A.M. Each night you can track Mars's motion against the stars — its easterly path takes it across the southern reaches of Ophiuchus. It is also large enough — 10" across — to allow most telescopes to see some detail. The brilliant Hellas Basin or the contrasting dark regions of Syrtis Major are easy targets for small scopes. Larger telescopes will be able to track the shrinking polar cap as winter ends in its Northern Hemisphere.

Mars outshines Antares, reaching magnitude –0.2 by March 31. Next month its easterly path against the stars will slow as Earth begins to overtake Mars, lining up for opposition in June. A last quarter moon on March 15 lies 5° west-northwest of Mars, forming an elegant triangle with Antares.

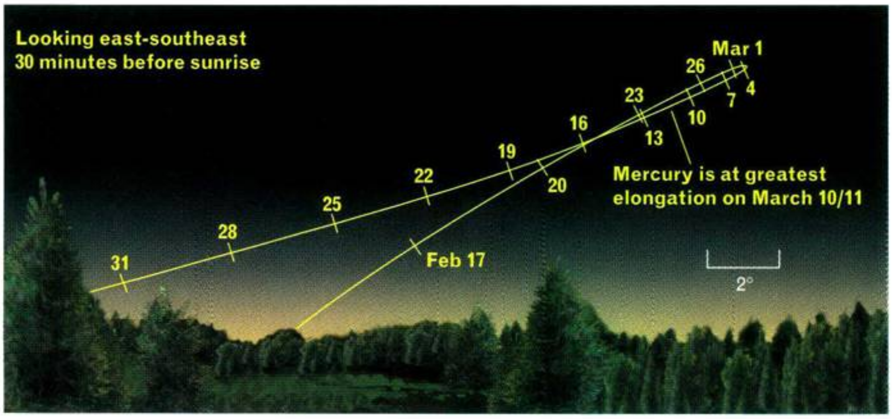
Early morning risers will be greeted by a brief appearance of **Mercury** at its greatest western elongation on March 11. It rises as the sky begins to brighten, and like all morning apparitions, it glows brighter after its greatest elongation. On March 7 it reaches magnitude 0.7, followed by a magnitude 0 appearance on March 22, when Mercury lies 4° northeast of a slim crescent moon.



Looking south-southeast
4 A.M., March 15



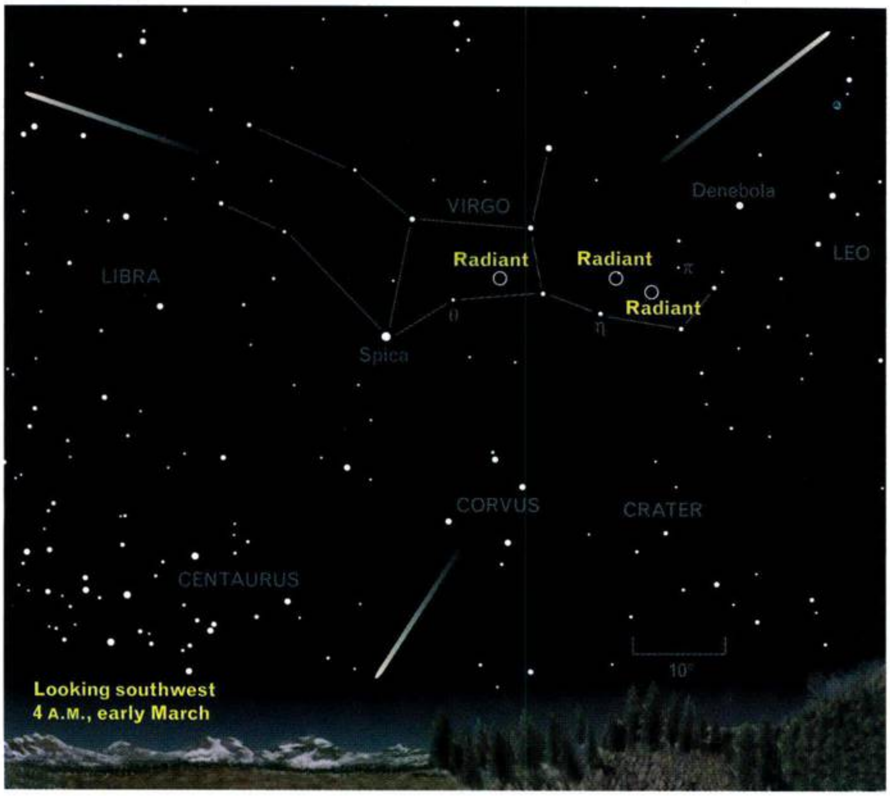
Looking west
8 P.M., March 28



Looking east-southeast
30 minutes before sunrise

Mercury is at greatest elongation on March 10/11

Meteors and Moons



Looking southwest
4 A.M., early March

Sunrise on Pitatus

Fascinating craters litter the moon, but have you tried to observe the changes in the crater Pitatus as the sun rises over its aged walls? Pitatus, 72 miles wide, lies northwest of Tycho on the shores of Mare Nubium. Ancient lava floods coat its floor. As the sun rises over the crater, its broken walls cast shadows across the inner plain. Suitable lighting will reveal gentle folds in the floor. Watch out for sunrise on Pitatus, which occurs on the evening of March 3. Telescopes of at least 10 inches are needed to spot the narrow rille that cuts across the crater floor following the inner wall, from its western reaches around its northern limit, over to the mountains that form its high eastern wall. Adjacent to the crater's western limit is the 26-mile (42-km) diameter Hesiodus. Steep mountains flank the valley between the two craters.

Amy Kennett

Jovian Satellite Events

A number of events involving Jupiter's satellites are on display for American viewers north and south this month and are listed below. Times are Central Standard Time and are accurate to within one minute. Io = I, Europa = II, Ganymede = III. No Callisto events are predicted. Oc = occultation; Ec = eclipse; Sh = shadow; Tr = transit; D = disappearance; R = reappearance; I = ingress; E = Egress.

Jovian Moon Events

Feb. 28	21:13	II.Oc.D.
	23:53	II.Oc.R.
	23:55	II.Ec.D.
Mar. 1	22:21	I.Tr.I.
	23:40	I.Sh.I.
	00:33	I.Tr.E.
Mar. 2	18:45	II.Sh.I.
	18:47	II.Tr.E.
	19:39	I.Oc.D.
	21:23	II.Sh.E.
	23:08	I.Ec.R.
Mar. 3	19:02	I.Tr.E.
	20:21	I.Sh.E.
Mar. 5	23:26	III.Tr.I.
Mar. 7	23:55	II.Oc.D.
Mar. 9	18:41	III.Ec.D.
	18:48	II.Tr.I.
	20:59	III.Ec.R.
	21:21	II.Sh.I.
	21:26	II.Tr.E.
	21:36	I.Oc.D.
	23:58	II.Sh.E.
Mar. 10	8:48	I.Tr.I.
	20:05	I.Sh.I.
	21:00	I.Tr.E.
	22:17	I.Sh.E.
Mar. 11	18:33	II.Ec.R.
	19:33	I.Ec.R.
Mar. 16	19:59	III.Oc.R.
	21:29	II.Tr.I.
	22:41	III.Ec.D.
	23:33	I.Oc.D.
Mar. 17	20:46	I.Tr.I.
	22:01	I.Sh.I.
	22:58	I.Tr.E.
Mar. 18	18:03	I.Oc.D.
	21:12	II.Ec.R.
	21:28	I.Ec.R.
Mar. 23	21:51	III.Oc.D.
Mar. 24	22:45	I.Tr.I.
Mar. 25	18:46	II.Oc.D.
	20:02	I.Oc.D.
Mar. 26	18:26	I.Sh.I.
	19:28	I.Tr.E.
	20:38	I.Sh.E.
Mar. 27	18:28	II.Sh.E.
	19:08	III.Sh.E.

A Smattering of Meteors

A diffuse complex of meteor showers track through Virgo this year. Three radiants are known, lying near the stars Eta (η), Pi (π), and Theta (ϕ) Virginis. These may also be the continuation of a late February shower, the Delta (δ) Leonids. Activity of each shower is low, but combined, they can produce something of interest to detemined meteor observers. The peak of activity occurs in early March, coinciding with a first quarter moon, so late night and early morning viewing are best. With rates of only five meteors per hour, patience is the principle agent, plus some luck to catch the slow-moving meteors.

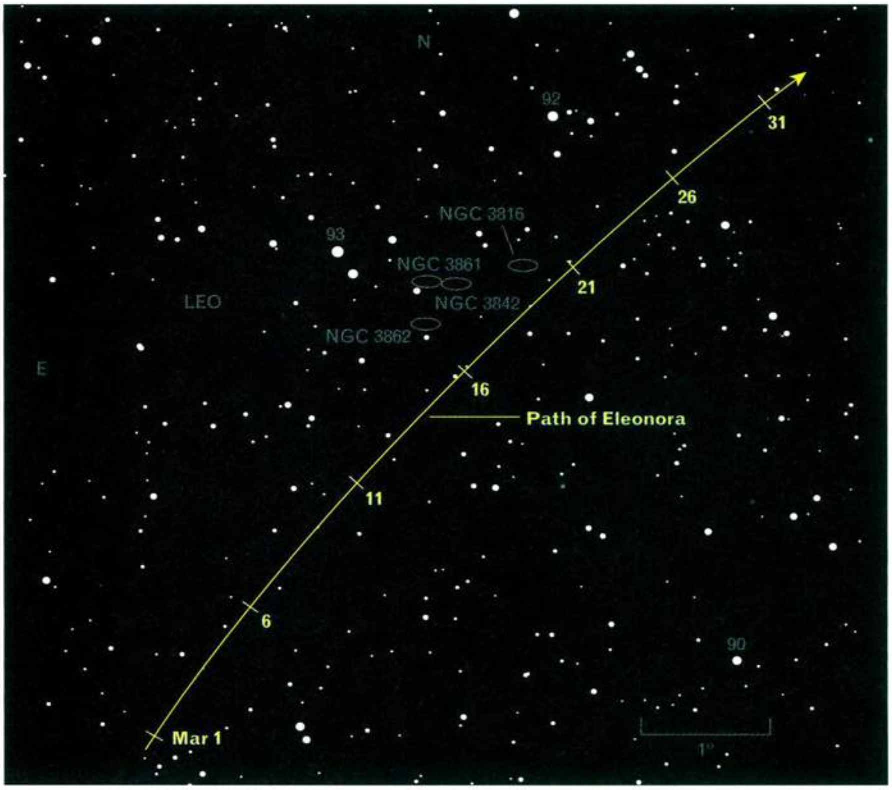
A Flea on the Lion's Back

Today's "terror of the skies" because of their possibility of striking a major blow to Earth with little warning, asteroids were once called "the vermin of the skies." As soon as astronomers could efficiently capture them on film, they couldn't seem to get rid of their trails. Armed with updated knowledge and impact possibilities, these days professional astronomers are looking at the rock quarry of the solar system in a different light.

From our earthbound perspective, asteroids eventually glide in front of galaxy country. This makes rock hunting all the more interesting because along the way you can observe galaxies that wouldn't otherwise show up on your to-do list.

Asteroid 354 Eleonora can be found climbing the hindquarters of Leo, north of Beta (β) Leonis. At 100 miles (160 km) across, the high-numbered Eleonora sports a reflectivity of 20 percent, about four times that of our moon, and glows at magnitude 9.8, suitable for a 4-inch scope under reasonably dark skies.

During the nights of the 18th to 22nd, Eleonora scoots one moonwidth, or 30', from a handful of galaxies of 12th to 13th magnitude, ripe for the taking in scopes of 10 inches or more. When searching, be sure to use 92 Leonis as an anchor star.

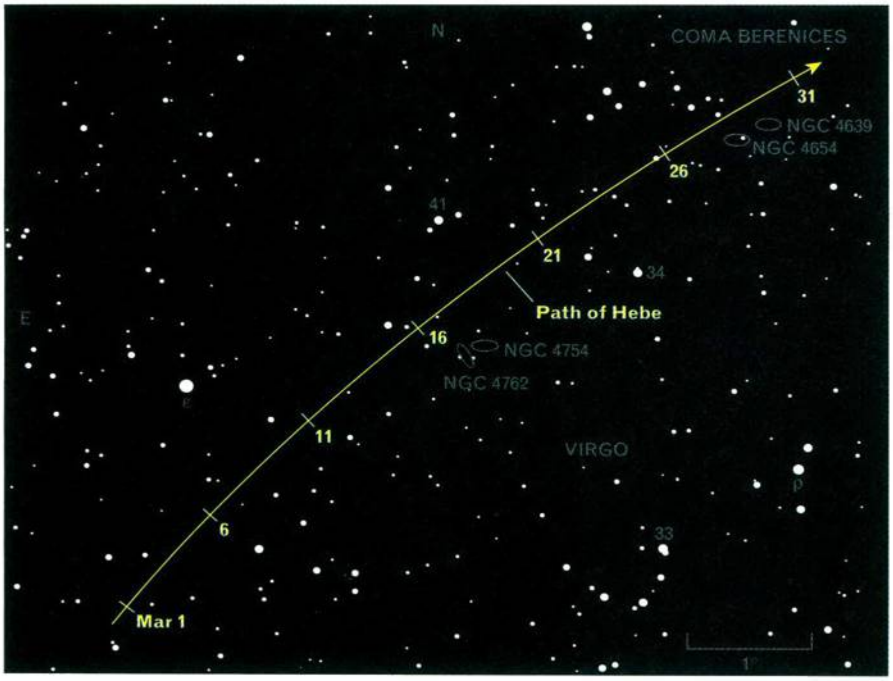


Hebe Reaches Opposition

Distance is everything. Asteroid 6 Hebe reaches its brightest point this month, magnitude 9.9. So despite being 20 percent bigger and somewhat more reflective than Eleonora, it's fainter. That's because Hebe is about 40 percent of the Earth-sun distance farther away — a considerable trek.

To view one of the first asteroids to be identified, zero in on the constellation Virgo the Maiden. Use the bright star Epsilon (ε) Virginis to jump to nearby 41 and 34 Virginis. On March 17, Hebe is a scant 30' northeast of the elongated, challenging 11th-magnitude galaxy NGC 4762.

For a daily close-up view of an asteroid that'll blow your mind, check out the images coming from the Near Earth Asteroid Rendezvous spacecraft at http://near. jhuapl.edu/.



Martin Ratcliffe is Director of Theaters at the Exploration Place in Wichita, Kansas. Alister Ling is a meteorologist working for Environment Canada in Alberta.

BBB MEMBER METROPOLITAN NEW YORK 2001

ADORAMA INC.

42 WEST 18th STREET • NEW YORK, NY 10011

PHONE ORDERS ACCEPTED DAY OR NIGHT
- Mon–Thurs. 9 till 9:30 PM
- Fri. 9-1:45
- Sunday 9:30–6 EST

STORE HOURS:
- Mon.–Thurs. 9–6:30pm
- Fri to 1:30 • SUN 9:30–5:30

web:
www.adorama.com

ORDER TOLL FREE • US & CANADA
800-7-ADORAMA
8 0 0 - 7 2 3 - 6 7 2 6
ORDERS & INFO **212-647-9800**
FAX **212-675-8715**
CUSTOMER RELATIONS • 800-815-0702
• Mon–Thur. 9–4:30, EST
E-mail: info@adorama.com

CELESTRON®
SCHMIDT CASSEGRAIN

New Celestron Nexstar

Celestar 8	**1099.00**
Hand Control f/Celestar	**54.95**
Celestar 8 Deluxe	**1699.95**
G-8 German Eq. 8"	**999.95**
Nexstar 5	**1199.95**
Nexstar 8 W/Tripod	**1699.95**

Celestron Reducer/ Corrector f/6.3

Works with all Current Celestron and Meade Schmidt Cassegrains. Now it is possible to have a dual focal ratio instrument without sacrificing image quality. The Reducer/Corrector is f/6.3 for C8 and C11, f/7 for C14. A four element, fully multi-coated accessory. Results are amazing BOTH visually and photographically.

104^{95}

ACCESSORIES for NEXSTAR 5"
JMI

Motofocus	**101.95**
Megapod Tripod w/Wedge	**199.95**
Carry Case	**129.95**
Celestron Tripod	**174.95**
Celestron Case	**149.95**

CELESTRON TELESCOPE ACCS.

AC Adpt. C5+, C8+ Ultima	**18.95**
Car Bat. Adpt. C5+,C8+ Ultima	**19.95**
2X Barlow 1.25" Short Tube	**39.95**
Counterweight Bar Assembly 8"	**84.95**
Case for C8/C5	**179.95**
Piggyback Mt 8"	**34.95**
Piggyback Bar Assembly 11"	**69.95**
New Folding Lens Shades	**Call**
MOTORS	
JMI DEC Motor C8+/Classic 8	**84.95**
JMI Motofocus f/Celestar 8, Nexstar 8	**101.95**
Celestron Focus Motor	**109.95**
Logic Drive f/CG3	**29.95**
S/A Drive w/Hand Cntrl f/CG-3	**79.95**
Single Axis Motor for CG-5	**114.95**
Dual Axis Drive for CG-4	**159.95**
Dual Axis Drive for CG-5	**169.95**
ADVANCED ASTRO MASTER	
Advanced Astro Master for C8 11, & G5 Mount	**474.95**
FILTERS	
LPR A	**59.95**
LPR B	**84.95**
Pol. Set 1¼"	**44.95**
Sky Filter #2	**44.95**
4 piece 1.25" FilterSet	**49.95**
DIAGONALS	
Diagonal Erect 1.25" 45°	**39.95**
Diagonal Erect 1.25" 90°	**49.95**
Star Diagonal 1.25" 90°	**34.95**
2" Mirror Star Diagonal	**124.95**

FINDERSCOPES	
9x50 Finderscope Kit	**79.95**
6x30 Finderscope Kit	**34.95**
7x50 Polaris Finder Scope with Illuminator & Bracket	**159.95**
Quick Release f/7x50 find	**42.95**
Star Pointer Finderscope	**24.95**
Polar Axis Finder f/CG-4/5	**44.95**
1.25" RACK & PINION FOCUSERS	
1.25" Focuser	**29.95**
GUIDING SYSTEM	
Radial Guider	**84.95**
Micro Guide Eyepiece	**139.95**
10mm Plossl Reticle	**84.95**
20mm Cross Hair Eyepce.	**34.95**
Standard Illuminator	**39.95**
TRIPODS & MOUNTS	
Adj. Tripod Heavy Duty	**264.95**
CG-3 Equatorial Mnt.	**149.95**
CG-5 Equatorial Mnt.	**399.95**
Photo Tripod	**99.95**
Vibration Suppression Pads	**39.95**
NIGHT VISION ASTROLIGHTS	
Night Vision LED Light	**14.95**
T-ADAPTER/TELE EXTENDERS	
Tele Extender Deluxe	**48.95**
T-Adapt. f/Schmidt Cassegrains	**24.95**
T-Adapter/Barlow Lens 1.25"	**39.95**
T-C 16mm Adapter	**29.95**

ULTIMA EYEPIECES

5mm, 1¼"	**67.95**
18mm 1¼"	**67.95**
35m 1¼"	**96.95**
7.5, 1¼"	**67.95**
30mm, 1¼"	**84.95**
2X Ultima Barlow Lens	**62.95**
12.5mm, 1¼"	**67.95**
42m, 1¼"	**89.95**

PLOSSL EYEPIECES

7.5, 17mm, 1¼"	**31.95**

NEXSTAR PLOSSL EYEPIECES 1.25"

3.6,6,8,10,13,17,25mm	**39.95**
32, 40mm,	**49.95**

AXIOM EYEPIECES

15mm 1¼"	**129.95**
19mm 2"	**169.95**
50mm 2"	**274.95**
19mm 1¼"	**139.95**
34mm 2"	**209.95**
23mm, 1¼"	**149.95**
40mm, 2"	**249.95**

Vixen Lanthanum Eyepieces LV Series

2.5mm,	**99.95**
4mm	**94.95**
6mm	**94.95**
12mm	**109.95**
5mm	**94.95**
9mm	**94.95**
15mm	**94.95**
10mm	**94.95**
8-24mm Zoom	**159.95**

Pentax XL SMC Eyepieces

5.2, 7, 10.5, 14, 21, 28mm, 1.25"	**219.95**
40mm, 2"	**239.95**

CELESTRON
NEW NEXSTAR REFRACTORS

Nexstar 60-ST	**189.95**
Nexstar 60-GT	**299.95**
Nexstar 80-HC	**299.95**
Nexstar 80-GT	**399.95**
New Nexstar 60/80 Soft Case	**79.00**
New Nexstar 80/114 Hard Case (for Scope only)	**99.00**

NEW NEXSTAR REFLECTORS

Nexstar 114 HC	**399.95**
Nexstar 114 GT	**499.95**

REFLECTORS

8" Reflector	**699.95**
C-150 Heavy Duty 6" Reflector	**499.95**

REFLECTORS

C80 Heavy Duty	**349.95**
Firstscope 80 EQ. #21070	**224.95**
Firstscope 60 Alt. Deluxe	**79.95**
Firstscope 60 Equatorial with Aluminum Tripod	**114.95**

STAR HOPPER
Dobsonian

4.5"	**219.95**
6"	**299.95**
8"	**389.95**
6x30 LER Finderscope	**39.95**

SPOTTING SCOPES

C90 MC w/1.25" Eyepiece	**Call**
Ultima 65	**129.95**
15-60X Zoom	**144.95**
80mm Wide Field with 2 Plossl Eyepieces	**Call**
New 102mm Wide	**Call**

COMPACT G5 5" SCHMIDT CASSEGRAIN
with Equatorial Mount

$699^{95}

SKYGAZER SERIES TELESCOPES

80mm Equatorial

910mm focal length (f/11.4) German Equatorial Mount, slow motion controls, setting circles, 25mm 1.25" eyepiece (36X), 1.25" diagonal, 6x30 finderscope, adjustable wood tripod only **224.95**

SPECIAL OFFER
80mm Refractor includes a FREE Single Axis Drive

STEREO BINOCULAR VIEWER
$479.95

Tele Vue®

WE STOCK THE COMPLETE LINE

of Tele Vue Plossls, panoptics, Naglers, Radians, Barlows & Powermates

TELE VUE REFRACTORS

PRONTO
70mm Aperture
f/6.4 with ED Glass
925.00

101mm and 85mm REFRACTORS

101mm	**2760.00**
85mm	**1995.00**

BUSHNELL

60mm Zoom Voyager Refractor	**79.95**
60mm Zoom Voyager Refractor with Rotary Eyepiece	**89.95**

Bushnell Compact 4.5" Reflector
$154.95

Features a unique cradle mount which is convenient to use and transport. A wide field of view makes it easy to locate objects and keep them in view
- Aperture: 4.5" • Focal Length: 400mm
- Eyepieces: 1.25" 4mm (100X), and 25mm (16x)
- Focuser: Precision Rack & Pinion,

Tripod adaptable, includes convenient shoulder strap

TELESCOPE ACCESSORIES

DEW SHIELD

Collapsible, fold down, easy to store and transport

for Celestron C90	**18.95**
f/8" Schmidt Cassegrains	**28.95**
f/5" Scopes	**24.95**
f/10" Schmidt Cassegrains	**38.95**
f/11" Scopes	**49.95**

LUMICON FILTERS

BUY ANY 2 FILTERS AND TAKE 7% OFF THESE PRICES

UHC Premium, Deep Sky Premium, H-Beta or Oxygen III

1¼"	**99.50**
48mm	**199.95**
2" T Mount	**199.95**

TELRAD FINDER

TELRAD with Base	**36.95**
Spare Mounting Base	**7.95**
Dew Shield for Telrad	**11.95**

EASY TESTER

Optical Evaluation Eyepiece	**29.95**

JMI FOCUSERS

NGF-DX1	**233.00**
NGF-DX2	**180.00**
NGF-S w/Motofocus	**242.00**
NGF-DX3	**144.00**

SOLAR FILTERS GLASS

for Celestron C90/G3 & Meade ETX-90	**59.95**
for Tele Vue 101/102	**59.95**
for Tele Vue Pronto/Ranger Televue	**49.95**
for Celestron Nexstar 5" & Meade ETX-125	**64.95**
for Schmidt Cassegrains 8"	**79.95**
for Meade 10"	**99.95**

WE SHIP PROMPTLY. ALL TELESCOPES INCLUDE U.S.A. WARRANTY

No Surcharge for MasterCharge or Visa Purchases. Personal checks welcome, will ship without delay. Name must be imprinted on check, also include address, phone, and a copy of major credit card or driver's license for reference. Shipping, handling and insurance additional. 14 day money back guarantee less shipping, with packing and blank warranty card, except film and paper. We ship UPS. Some items special order. All orders are subject to acceptance and verification. Second hand dealer's license #802862. Pictures are for illustration purposes only and may not be exact. Wa are not authorized Meade dealers.

Prices effective till March 10, 01 **Please address all inquiries and orders to ASTRO. DEPT. #55**

Your Credit Card Will Only Be Charged At Time Of Shipping For Items Actually Shipped

BBB 2001

ADORAMA INC.

42 WEST 18th STREET • NEW YORK, NY 10011

PHONE ORDERS ACCEPTED DAY OR NIGHT
- Mon–Thurs. 9 till 9:30 PM
- Fri. 9-1:45
- Sunday 9:30–6 EST

STORE HOURS:
- Mon.–Thurs. 9–6:30pm
- Fri to 1:30 • SUN 9:30–5:30

web:
www.adorama.com

ORDER TOLL FREE • US & CANADA
800-7-ADORAMA
8 0 0 - 7 2 3 - 6 7 2 6
ORDERS & INFO **212-647-9800**
FAX **212-675-8715**
CUSTOMER RELATIONS • 800-815-0702
• Mon–Thur. 9–4:30, EST
E-mail: info@adorama.com

BINOCULARS

Adorama Provis Series Binoculars

Deluxe, Lightweight with enhanced Multi-Coating. Full-sized binoculars in a compact and lightweight high-quality cast-aluminum alloy housing with a soft leatherette covering.

- BAK-4 glass porro prisms.
- Full Multi-Coating. Every air-to-glass surface is multi-coated to increase light transmission, better image contrast and color balance
- Soft grey leatherette covering
- Threaded to accept tripod adapter
- Long Eye Relief. ideal for eyeglass wearers
- Roll down rubber eyecups
- Supplied with Deluxe Hard Carrying Case
- Rated "Exceptional Inspection Standard" by the Japanese J.T.I.I.

PROVIS Binocular	Eye Relief	Field of View	Near Focus	Size HxW	Weight oz.	Price
8x42	16mm	6.5°	16'	4.92" x 6.85"	22.2	**129.95**
7x50	23mm	6°	26'	6.42" x 7.24"	27.8	**109.95**
10x50	16mm	5.3°	26'	6.22" x 7.24"	27.8	**124.95**

NIGHT VISION

BINOCULARS
Compact Binocular 30,000X 4X Mag. **399.95**
30,000X Goggles 1X Mag. Focuses as close as 9" ..**574.95**

MONOCULARS
NOCX3 Explorer water Resistant 3.1X Mag. 15,000X ..**199.95**
NOCX5 Explorer water Resistant 5X Mag. 15,000X ...**274.95**
NONO3 Odyssey water Proof 3.1X Mag. 15,000X**249.95**
Lens Doubler ..**34.95** Camera Adapter **34.95**

TASCO
NV-360 **Monocular** **279.95**
Camera Adapter for 360 ....**49.95**

Night Owl Cyclops With Camera Adapter

- 15,000 Light Magnification
- 3.1x Image Magnification
- Premium performance and styling
- The highest quality optics designed and coated specifically for night time use
- Powerful integrated infrared illuminator

164.95

ASTRONOMY BOOKS

Books for Beginners
Nightwatch: Equinox Guide ...**24.95**
Astronomy: Self-Teach Guide **18.95**

Astrophotography & Imaging
CCD Camera Cook Book.........**29.95**

Observers' Handbooks
The Backyard Astronomer's Guide **29.95**
Burnham's Celestial Handbook 3 Volume Set **39.95**

Binocular Observing
Touring the Universe Through Binoculars **32.95**

Building Telescopes
Telescope Building w/Dobson Video Tape........**39.95**

Star Atlases
Sky Atlas 2000 Field Ed. **29.95**
Sky Atlas 2000 Deluxe New Ed. **44.95**
Laminated Sky Atlas 2000 Field Edition **64.95**
Bright Star Atlas 2000 ....**10.95**
Celestron Sky Map.................**16.95**
Atlas of Deep Sky Splendors 4th Edition **24.95**
Deep-Sky Field Guide to Uranometria 2000..............**49.95**

Night Navigator *$79.95*
The Electronic Star Locator

Locates and Identifies Constellations Quickly.
- Scientific patented computer tracking system to accurately locate and identify constellations, planets, and stars quickly and effortlessly.
- Innovative built-in digital electronic compass automatically plots your location.
- Motorized map delivery system for easy sky navigation.

ASTRONOMY SOFTWARE

THE SKY for Windows 95
Sky Level 2 or 3 ....**Call**
Sky GSC (CD ROM) Level 4................**Call** *Version 5.0*

We Now Carry The
STARRY NIGHT PRODUCTS

PRO*OPTIC* BINOCULARS

Now includes 25 YEAR WARRANTY

These binoculars with their large objectives high quality BAK-4 prisms will provide you with breath-taking wide-field observation of astronomical objects as well as terrestrial viewing under low light conditions.

Each binocular is provided with a high quality Hard Case, Neck Straps and Rubber Eye-Cups.

70mm Jumbo Fully Multi-Coated Series

11x70 Jumbo – 4º field of view, 21mm eye relief, weighs 2.8 lbs. **159.95**
16x70 Jumbo– 3.6º field of view, weighs 2.8 lbs. **169.95**

80mm Giant Fully Multi-Coated Series

11x80 Giant – 4.2º field of view, 14mm eye relief, weighs 5.25 lbs. **249.95**
20x80 Giant – 3.3º field of view, 14mm eye relief, weighs 5.25 lbs. **259.95**

100mm Ultra Giant Series

The ultra large aperture of 100mm provides more than 50% more light gathering power than the standard 80mm Giant Binoculars.
For a delightful experience in astronomical viewing.
Both feature multi-coated optics, BAK-4 prism, built-in platform which mounts on a tripod.

14x100 Ultra Giant...**849.95** **25x100** Ultra Giant.**899.95**

Provides Stunning Views of The Night Sky
At A Price Far Below What Giant Binoculars Typically Cost
...BUDGET - PRICED...
As Written Up In Sky & Telescope June 2000

FUJINON FMT-SX Binoculars

10x70

14x40 Techno Stabi ....**Call**
7x50 FMT-SX........................**Call**
7x50 FMTR-SX ....**Call**
7x50 FMTR-CSX R.C.with Compass................**Call**
8x30 FMTR-SX R.C................**Call**
10x70 FMT-SX w/Case ....**Call**
16x70 FMT-SX w/Case..........**Call**
8x42 BFL.............................**Call**
10x42 BFL...........................**Call**

CD Waterproof
7x42 ....**Call** 8x42 ....**Call**
10x42 ......**Call**

CANON
Image Stabilized
10x30 ....**Call** 12x36 ....**Call**
15x50 ....**Call**
18x50 ....**Call**

PENTAX PCF
7x50...........**Call** 8x40. ....**Call**
10x50..........**Call** 12x50. ......**Call**
16x60..........**Call** 20x60 ....**Call**

LEICA
w/USA Passport Warranty
Call about New close focus Binoculars
10x50 BA ...**Call** 8x50 BA ....**Call**
12x50 BA ....**Call**
7x42 GEOVID BDA ....**Call**
7x42 GEOVID BD...................**Call**

KOWA 82mm
w/20 to 60x Zoom
TSN-821...............**639.** TSN-822 ....**609.**
TSN-823 ....**1059.** TSN-824 ....**1014.**

W/O Eye Piece
TSN-821..........**399.95** TSN-822.......**364.95**
TSN-823..........**814.95** TSN-824.......**769.95**
27x L.E.R. ....**134.**
32x w.a. ....**194.**
20-60x Zoom Eyepiece **264.95**
PA2-C 82mm Photo Adapt. **174.95**
20-60x f/60mm.....................................**139.95**

Fieldscope Super 80
Super 80 with 20X-60X..........**Call**
Super 80 ED with 20X-60X.......**Call**

CELESTRON
GIANT MULTI-COATED
20x80 Delux ....**Call**

REGAL
8x42 ....**Call** 10x50 ....**Call**

NEW NOBAL
8x32...........**Call** 8x42. ....**Call**
10x42.........**Call** 10x50 ....**Call**

ULTIMA SERIES
7x50...........**Call** 8x40. ....**Call**
10x50.........**Call** 8x56 ....**Call**
9x63...........**Call**

MINI M/C with Case
8x21...**36.95**
10x25......**46.95** 7-16x25 .**64.95**
MONOCULAR– 8x25 ....**34.95**

BUSHNELL
Discoverer 15x60 Zm **179.95**
Camera Adapter **14.95**
Case f/Discoverer...............................**19.95**
Nature View 15-45X..........................**124.95**
Car Window Mount.............................**34.95**

SPACEMASTER 60mm
78-1800 Basic **149.95**
78-1817 Basic Kit................................**247.95**
78-1200 Rubberized Arm **163.95**
78-1217 Rubberized Kit **259.95**
78-2317 RC Zoom **229.95**
78-2318 RC L.E.R. Zoom **224.95**
78-1821 RC L.E.R. ZM Kit **264.95**
60x Eyepiece......................................**33.95**
15-45X Zoom Eyepiece **89.95**
20-45X L.E.R. Zoom **89.95**

ELITE Waterproof
15-45 60mm w/Case ....**Call**
20-60x 70mm w/Case ....**Call**
20-60x 80mm w/Case ....**Call**

PRO*OPTIC*
Astronomical Accessories
A unique combination of high quality and economical prices

Pro-Optic Plössl 1.25" Eyepieces

NEW Reduced Prices!

- Sharp detail • High contrast ghost-free images • Wide 50º apparent field of view (43º on the 40mm Plössl)
- 4 element optics
- Lens edges are blackened to keep out reflected light
- Accepts 1.25" filters.

MULTI-COATED PLÖSSL EYEPIECES
40mm......**39.95** 32mm.......**39.95**
25mm........**29.95** 20mm.......**29.95**
17mm........**29.95** 12.5mm....**29.95**
10mm........**29.95** 7.5mm......**29.95**
6.3mm.......**29.95**

Short Tube Barlow

Double the power of any eyepiece with this Barlow. Only 2¼" long. Works with all type of telescopes, including Refractors and Reflectors

only **$31.95**

Pro Optic 500mm f/5.6 Maksutov Telephoto/Spotting Scope

with High-Tech White Finish
Carry Case
Pro-Optic

Multi-coated to maximize contrast and sharpness and a built-in field flattener to reduce field curvature.
With its 500mm focal length, it is long enough for close-ups of far away objects but with the f/5.6 optics it is fast enough to be hand held, focuses as close as 5 feet.
With the addition of the SS500 Kit you can convert it to a 20X 90mm spotting scope. The SS500 kit includes a 45º 1.25" Erect Image Diagonal and a 25mm 1.25" Plossl

Pro-Optic 500mm f/5.6 lens **209.95**
Pro-Optic SS500 Kit (when purchased w/500/5.6) **49.95**
350mm f/4 Converter for 500/5.6 ....**74.95**

15-45x Fieldstar Spotting Scope Outfit Fully Coated, 2.25° f.o.v. at 15x, Long Eye Relief (33mm @ 15x) weighs only 25 oz,
• Rubber Coated
includes Case & Table Top Tripod

109.95

New 15-45x Angle Spotting Scope Kit w/Case & Table Top Tripod **119.95**

Pro-Optic Slow Motion Control ***29.95***

Make accurate slow motion adjustments in altitude and Azimuth. In addition the Pro-Optic SMC allows you to make major adjustments in elevation with a separate control knob.The Slow Motion Control fits any tripod with 1/4-20 thread.

Pro-Optic 45º Erect Image Diagonal

Provides an ideal 45º angle for erect image terrestrial viewing
45º Erect 1.25" **34.95**
45º Erect Hybrid (1.25" to .96") **34.95**
90º Star Diagonal 1.25"...**34.95**
New Straight Through Erector (Porro Prism) **64.95**

EYEPIECE FILTERS 1.25"

Available in the following colors: 1A Skylight; 8 Yellow; 11 Yellow Green; 12 Yellow; 15 Deep Yellow; 21 Orange; 23A Red; 25 Red; 47 Violet; 56 Light Green; 58 Green; 80A Lt. Blue; 82A Pale Blue; ND 0.3; ND 0.6

1.25" ....@. **9.95** Moon Filter 1.25" (ND 9X).........**11.95**
Buy any 4 filters (1.25") ..for only **34.95**
Buy any 12 filters ....for only **99.95**

4 Piece Filter Set with Pouch
Set #1 includes: #12, 23A, 58 & 80A Packaged in a Pouch **34.95**
Set #2 includes: #11, 25A, 47 & 82A **34.95**

WE SHIP PROMPTLY. ALL TELESCOPES INCLUDE U.S.A. WARRANTY
No Surcharge for MasterCharge or Visa Purchases. Personal checks welcome, will ship without delay. Name must be imprinted on check, also include address, phone, and a copy of major credit card or driver's license for reference. Shipping, handling and insurance additional. 14 day money back guarantee less shipping, with packing and blank warranty card, except film and paper. We ship UPS. Some items special order. All orders are subject to acceptance and verification. Second hand dealer's license #802862. Pictures are for illustration purposes only and may not be exact. Wa are not authorized Meade dealers.
Prices effective till March 10, 01 **Please address all inquiries and orders to ASTRO. DEPT. #55**

VISIT US ON THE WEB AT WWW.ADORAMA.COM

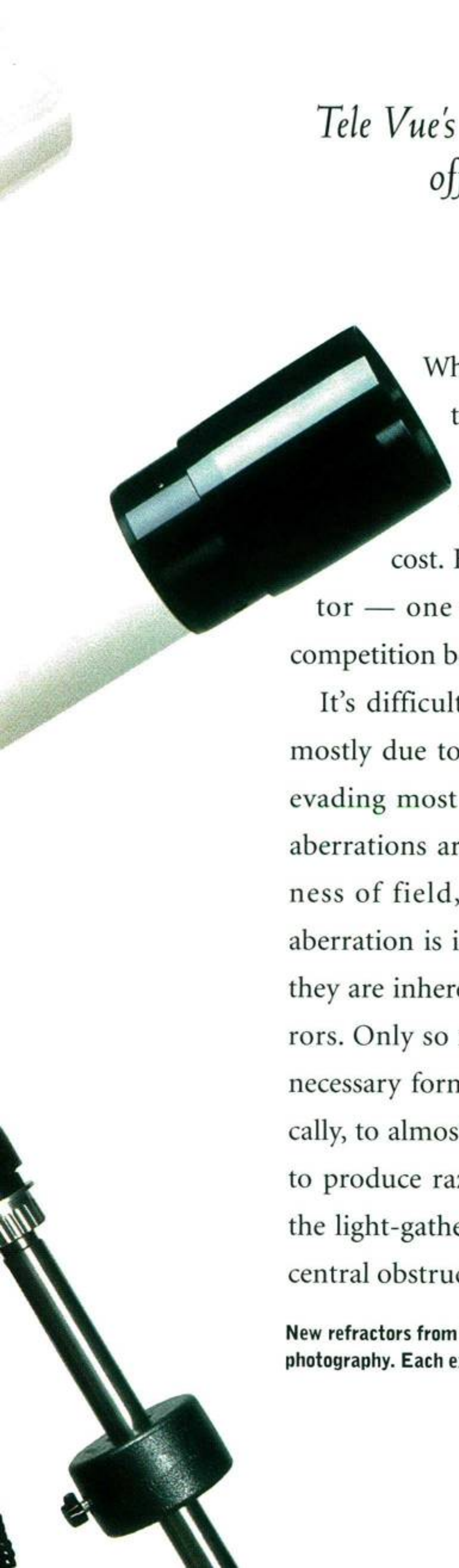
Big Scopes Go

ORION
TeleVue-101

Nose to Nose

Tele Vue's 101 and Vixen/Orion's VX-120GP refractors offer sharp optics for discerning observers.

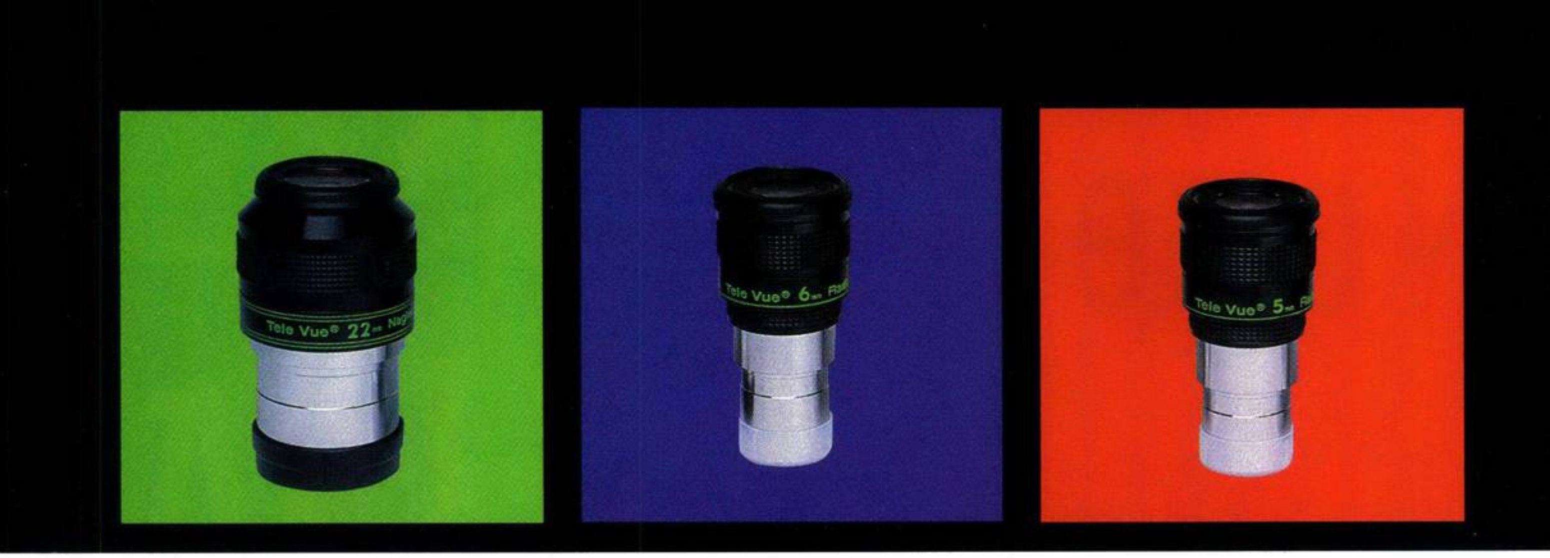
by Rod Pommier



When shopping telescopes, the age-old first question is, "reflector or refractor?" While each design has advantages and disadvantages, reflectors are frequently chosen by amateur astronomers because they offer more aperture for less cost. However, if you are willing to purchase a "high-end" refractor — one with an aperture of four inches or greater — then the competition between refractor and reflector becomes stiff indeed.

It's difficult to beat the performance of a high-end refractor. This is mostly due to their sharp, impressive optical performance, the result of evading most of the flaws that can affect optics. The six major optical aberrations are astigmatism, coma, spherical aberration, distortion, flatness of field, and chromatic aberration. Some coma and spherical aberration is inevitable with reflectors, including Schmidt-Cassegrains, as they are inherent properties of their parabolic and spherical primary mirrors. Only so much correction can be made without deviating from the necessary form of the mirror. But glass lenses can be corrected, theoretically, to almost any degree for all six aberrations, enabling good refractors to produce razor-sharp images with superior definition. Combined with the light-gathering and resolution capabilities of a large aperture with no central obstruction, the results can be astounding.

New refractors from Vixen/Orion and Tele Vue offer sharp optics and high-end capability for observing and photography. Each excels at high-resolution observing. William Zuback/*Astronomy*



On the other hand, chromatic aberration is unique to refractors and is visible as colored fringes around bright objects, resulting from different wavelengths (colors) of light coming to focus at different focal lengths. It can be corrected by using two lenses with different refractive indices (called a doublet) that the designer chooses to balance against each other to render the final image as achromatic as possible. Such a refractor is called an achromat. Reflectors are completely achromatic because the law of reflection is independent of the wavelength.

Two high-end achromatic refractors merit close consideration by telescope buyers: the Tele Vue 101, from Tele Vue of Suffern, New York, and the VX120 GP, made by the Japanese company Vixen and sold by Orion Telescopes in Santa Cruz, California. The Tele Vue 101 is a 4-inch (101mm) f/5.4 refractor identical to the former Tele Vue Genesis, with one major difference. The front doublet uses proprietary new glasses that Tele Vue boasts will set a new world standard in color correction for refractors, producing truer star colors and revealing delicate details on planets. The VX120 is a 4.7-inch (120mm) f/6.7 refractor that Orion claims boosts performance beyond that of a standard achromat by using a four-element, two-group lens assembly called a "neo-achromat." They state the extra doublet provides added color correction and field flattening for a truer, more pleasing image. While I tested these scopes in different areas, I was particularly interested in comparing their color correction and seeing if these bold claims were true.

Out of the Box

The Tele Vue 101 comes in a molded plastic case, which seals with O-rings and unique locks. The case is formfitted with extra slots for eyepieces and accessories. The tube is metal, powder-coated, and white. The dew cap is black anodized metal with the inside lined with felt to absorb moisture. The dew cap slides back over the optical tube when not in use, permitting storage in a smaller case. The lens cap is a metal plate that screws in place, which was a little difficult to manipulate with gloved hands. A flange around the edge would make it much easier to handle while wearing gloves. The optical coatings on the objective appeared dark purple. The focuser is black anodized metal with a chrome drawtube. The focusing knobs are large, made of metal, and have treaded rubber grip rings, similar to those on Tele Vue eyepieces. A screw is provided to lock the focus at any desired point. The rack and pinion focuser has smooth and precise movement.

The VX120 comes in two cardboard boxes. A padded case, which holds the complete scope, tripod, and mount is available from Orion for $59.95. The optical tube has an attractive white enamel finish. The dew cap is not retractable, and is painted flat black inside. The lens cap is metal and slides over the aperture. The flange along its edge makes it easy to grip with gloved hands. It has a capped, smaller aperture in the center to permit stopped-down solar projection viewing of the sun. The coatings on the objective also appeared dark purple. The focuser is gray painted metal with a chrome drawtube, and the focusing knobs are plastic. They were not mounted perpendicular to the rod connecting them, causing an annoying wobble as they were turned. This rack-and-pinion focuser also has a locking screw, and the focusing action was smooth and precise.

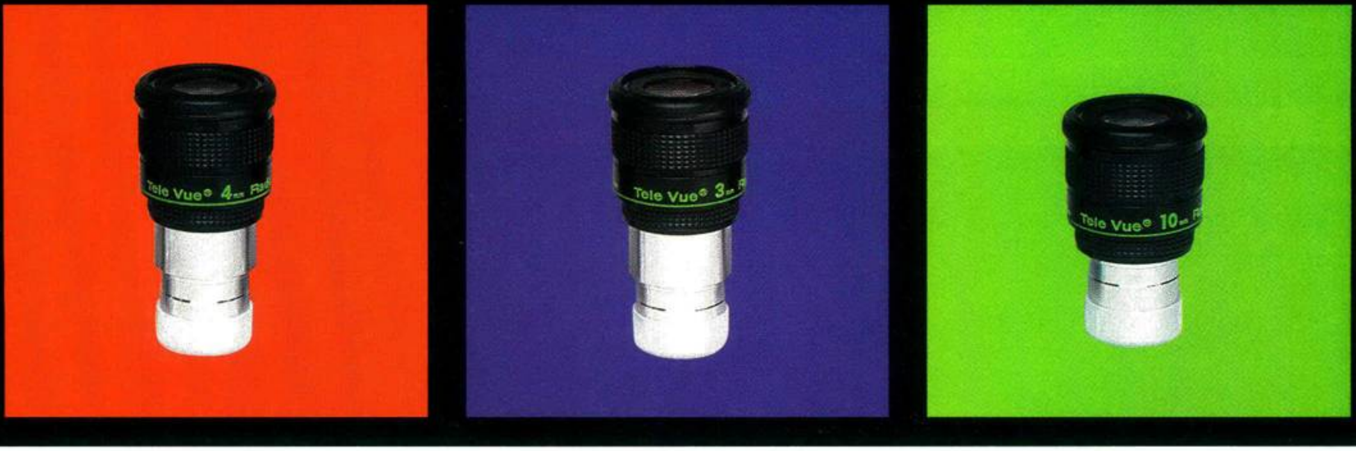
Star Diagonals

Star diagonals are essential for comfortable overhead viewing with refractors. The 101 has a built-in mirror diagonal in a metal housing that accepts two-inch eyepieces. A metal adapter permitting use of 1 1/4-inch eyepieces is included. Setscrews to hold eyepieces in place are provided.

The VX120 uses a detachable prism diagonal in a plastic housing. Setscrews to lock the diagonal in the focuser and eyepieces in the diagonal are provided. The diagonal accepts only 1 1/4-inch eyepieces. The VX120 may be adapted for use with two-inch eyepieces by disassembling the terminal end of the focuser and adding an accessory. Both telescopes can be adapted for prime focus astrophotography. Given their fairly short f/ratios, wide-field astrophotography should be possible, provided they have flat fields.

Finderscopes

The 101 has no finderscope. Rather, with a low-power eyepiece in the star diagonal, the 101 can be used as its own finder. With a 55mm eyepiece, the field of view is a whopping 4.9°, wide enough for all three belt stars in Orion or ten full moons. Once the desired object is centered, a high-power eyepiece may be substituted. I was initially skeptical about this technique but tried it using my 35mm Panoptic eyepiece, with which the field was still 4.1°, and it worked very well. One may also simply remove the eyepiece and look through the star diagonal from a distance of about a foot. This gives a wide field of view through the objective. Alternatively, a Starbeam "red dot" reflex sighting finder may be purchased separately.



Taking advantage of a high-end refractor's sharp optics means using high-grade eyepieces as well, like these Nagler and Radian models.

The VX120 comes with a 7x50 achromatic finder mounted in a gray metal bracket. The finder is aligned using three finger screws at the front of the bracket and three nuts at the rear of the bracket. The nuts are adjusted with a small Allen wrench, which I quickly lost in the dark. The nuts also mar the finish on the finder. Another set of finger screws would be preferable. The finder is achromatic and has a generous 6.8° field and sufficient light-gathering power to find dim deep-sky objects. The mounting bracket attaches quickly and firmly to the main tube with a dovetail plate and setscrew while maintaining any alignment previously set between the finder and main optical tube.

Mountings

The 101 comes with no tripod or mount. I was provided with the optional ash wood adjustable tripod and the Gibraltar altazimuth mount for testing. This comes in a tripod bag with handles, straps, and accessory pockets for an additional $455. The Gibraltar mount is ready to accept optional position sensors for computer-guided location of objects in altazimuth mode. The movement is very smooth and the mount has locks on both axes. The tripod was quite hefty, which made it very stable. The Gibraltar mount did exhibit some noticeable oscillations for a few seconds after touching or moving the scope, but there was no noticeable movement from the wind. An accessory tray is included. The 101 is adaptable to equatorial mounts as well.

The VX120 comes with an aluminum tripod and is mounted on the Great Polaris (GP) equatorial mounting. The aluminum tripod has an accessory tray and is adjustable and very lightweight. The GP mount has an illuminated polar finderscope built into the R.A. axis and smooth altitude and azimuth adjustment screws for precise polar alignment. The movement in both axes was smooth, with no noticeable backlash. It has plastic slow motion and lock knobs on both axes. The catalog shows an extension handle for the declination slow motion control, but none was found in the boxes. A difficulty I had was reaching the declination lock knob while centering objects in the finderscope or eyepiece. The optical tube is long enough that it is a difficult reach even for someone with arms as long as mine. Perhaps locking it in the general vicinity of the target and then making final adjustments with the slow motion cable would work better, but I had no cable.

The GP proved to be a superb mount that was very stable, showing very minimal oscillations after touching the scope and rock-steady images the rest of the time, even in brisk winds. It truly made observing with the VX120 a much more enjoyable experience. The GP may be equipped with an optional clock drive or the SkySensor "Go To" pointing system. The VX120 tube on this mount gives a very impressive appearance to this telescope.

Putting Them to the Test

For viewing the moon and planets, I tested both scopes in my Pro Dome-10 observatory in Portland. For deep-sky and star testing, both were tested under the very dark skies of the high desert in central Oregon. Testing was only conducted on nights when the seeing was 7 to 8 on a scale of 10, with 10 perfect, and transparency 3 to 4 on a scale of 5, with 5 being perfect. All objects were viewed when at maximum possible elevation in the sky. Although the 101 comes with a 20mm Tele Vue Plössl eyepiece and the VX120 comes with a 20mm Lanthanum series eyepiece, I tested both scopes with the same series of eyepieces consisting of a 22mm Nagler Type 4, and 10mm, 6mm, 5mm, 4mm, and 3mm Radian eyepieces, all by Tele Vue.

Removing the diagonals and looking at the dark sky through the optical tube revealed that both scopes had good baffling, with no extraneous light transmission. I was surprised to see that the second doublet in the VX120 is near the focuser, not behind the objective doublet, where I expected it to be.

I initially tested optics by viewing the bright stars Vega and Altair under high power. Both scopes revealed a clean, circular Airy disk, surrounded by a single, faint diffraction ring. Diffraction patterns were checked inside and outside of focus. Oval patterns that change axis 90° from inside to outside of focus indicate astigmatism, while asymmetric patterns indicate misaligned optics. Both telescopes revealed the patterns to be circular and symmetric on both sides of focus, showing no obvious signs of astigmatism or misalignment.

I tested the telescopes further for astigmatism by viewing the "Double-Double," Epsilon Lyrae, under very high power, placing the two pairs as far apart as possible in the field of view. An astigmatic lens would require a slightly different focus for each pair of stars, whereas a lens without astigmatism will bring both doubles into focus at the same focal

point. Each scope did just that, and a nice dark sky appeared between each pair of double stars in both.

Flatness of field and coma were tested by viewing the star-filled region around Sadr (Gamma Cygni) under low power. In both scopes, stars were in sharp focus from the center of the field to the very edge, indicating excellent flatness of field. Neither scope showed any hint of coma, which would be indicated by stars near the edge of the field changing to cometlike images, with tails all pointing away from the center. Also, neither scope showed any vignetting, which would be seen as dimming of stars as they are moved from the center to the edge of the field.

However, when it came to color correction, there was a clear difference between the two refractors. The 101 gave a brilliant white image of Vega, with no hint of color fringe whatsoever. Even a very good achromat may show some color fringing of the diffraction patterns inside and outside of focus, but in the 101 they remained soft white, with only a barely perceptible hint of color fringe.

However, in the VX120, Vega was surrounded by an obvious fringe of purple. The diffraction patterns inside and outside of focus were colored yellow, green, and purple. I tested both telescopes on Arcturus to see if this would occur with a different color star. In the 101, Arcturus was orange-yellow with no color fringe, and the diffraction patterns inside and outside of focus were also orange-yellow. In the VX120, Arcturus was orange-yellow surrounded by the same purple fringe, and the diffraction patterns in and out of focus revealed the same color scheme as seen with Vega. The problem persisted with the ruddy star Antares.

When tested on the moon, the VX120 showed a yellow-green fringe just inside the lunar limb. I couldn't see a purple fringe outside the lunar limb because the moon was so bright compared to the background sky. However, there was a remedy. Placing the moon's image just off the edge of the field of view revealed the purple fringe. In contrast, no chromatic aberration could be detected around the moon using the 101.

The chromatic aberration of the VX120 is only visible with the brightest objects and stars. It isn't noticeable when scanning the Milky Way or viewing deep-sky objects and is also less noticeable in the city than at a dark-sky site. Still, the virtually perfect color correction of the 101 is extraordinary. The views of the moon and planets through both refractors were rewarding. Both scopes produced views with crisp, excellent detail. Fine details visible with the 101, with its near perfect color correction, were also seen in the VX120, where the larger aperture seemed to make up for some of its chromatic aberration. The chromatic aberration of the VX120 did degrade some of the detail in Jupiter's belts and Saturn's rings under high power.

Testing numerous double stars showed that both scopes performed at or near their respective theoretical limits of resolution on nights of good seeing. The VX120 split very close double stars more readily than the 101, but again, this is attributable to its larger aperture rather than superior optics. For deep-sky objects, the VX120 gave very pleasing views of nebulae, galaxies, and globular clusters, resolving many individual stars in the globular clusters.

The sharp optics provided by refractors show not only planets and double star well but also the myriad stars, hazy gas clouds, and dark structures in nebulae, too. Tony and Daphne Hallas

Rating the High-end Refractors

Tele Vue 101

Advantages	Disadvantages
• Superb optics	• Smaller aperture
• Superb color correction	• Higher cost
• All metal with great finish	• Mount purchased separately
• Case included	

VX120 GP

Advantages	Disadvantages
• Extremely good optics	• Chromatic aberration
• Larger aperture	• Some plastic parts
• Comes with excellent equatorial mount	• Case purchased separately
• Lower cost	

The 101 also did extremely well on deep-sky objects but, with its smaller aperture, didn't have as much light-gathering power as the VX120. Fewer stars were resolved in globular clusters, less nebulosity was visible and dust lanes were not as noticeable in nebulae and galaxies, but the images were again slightly crisper than with the VX120.

How They Stack Up

At $2,195, the VX120 provides a large aperture refractor on a good equatorial mounting at a reasonable price. The optics were extremely good, being quite free of astigmatism, spherical aberration, and coma. The light-gathering power of the 4.7-inch objective produced high-definition images of the moon and planets and good resolution and detail with deep-sky objects. However, while the second doublet of the "neo-achromat" did produce a flat field, it clearly didn't render the telescope achromatic. Although this chromatic aberration is only directly visible while viewing the brightest objects, it was nonetheless disappointing and annoying when viewing such objects. I believe this resulted in some loss of crispness of all images, compared with those seen in the 101.

Despite its somewhat smaller aperture, at $2,800, just the optical tube of the Tele Vue 101 costs considerably more than the entire VX120 with mount. An altazimuth mount for this scope will add some expense, and an equatorial mounting that can track objects across the sky will add even more expense. However, the 101 has superb optics with virtually perfect color correction. It is wonderfully corrected for all six major optical aberrations. It also yielded truer star colors than I have ever seen and revealed delicate details on the moon and planets, as claimed. The color correction adds a new level of crispness and sharpness to every image seen through it. I believe the 101 will set a new world standard in color correction for refractors.

So take your pick, based on your interests, needs, and budget. Either way, you'll get a great amount of telescope for your dollar. ■

Rod Pommier is a surgical oncologist in Oregon. He regularly pursues observing and astrophotography from his backyard observatory.

Is the Univ

Spring grass and crocus buds. Green is the gown worn by March.

As evening descends on St. Patrick's Day, Irish paraders will pack their bagpipes, and backyard astronomers will scan the heavens for emerald hues. The naked eye has no trouble finding white, yellow, orange, and blue stars; a small telescope reveals reds, and one star — Cor Caroli — even looks pastel purple to me. Thanks to chlorophyll, Earth is verdant, but no star looks leafy green.

Forget the green stars listed in handbooks. Guides to double and binary systems, especially those written more than a couple of decades ago, listed dozens of "greens." Orange Antares, for example, is still often said to have a greenish companion. Many of us who began observing back in the 1960s and 70s felt as if we were at a parade led by a bare-butted emperor; why weren't we seeing green?

About one in 10 men has some degree of color blindness (women are rarely affected), but my astronomy buddies and I had no such problem. Yet we couldn't find any green, even with the help of a four-leaf clover for good luck. It started to resemble the issue of "red" giants. Books still routinely list Betelgeuse as "red" when, darn it, it looks yellow-orange!

Your telescope's field can brim with cosmic clover,
if you know where to look.

by Bob Berman

erse Irish?

Patrick Moore, William Tyler Olcott, and the other venerable handbook authors who listed green stars probably weren't resorting to blarney; it may simply be that they saw Antares's complementary color projected onto the nearby star's white surface. It's similar to staring longingly at a red exit sign during a boring play; a ghostly greenish "afterimage" floats in the air.

Afterimages are common companions for backyard observers because we often stare at objects of vastly differing brightnesses. The three types of color receptors in the retina, the sensory membrane that lines the eye's interior wall, give rise to the phenomenon. These receptors, called cones, respond to red, green, and blue wavelengths of light. The colors we see actually are the brain's interpretation of the impulses from the cones. But the eye can play tricks on the brain. For example, when you stare at a red light for 15 to 20 seconds, the red receptors grow tired. When you look away, a complementary blue-green afterimage briefly appears. Fixate on a green light and you will detect a magenta ghost.

Cameras can't record such afterimages. St. Patty's stellar ambitions seem doomed because nobody has produced a single astrophoto of a green star.

Previous page: This aurora above New Liskearh, Ontario, Canada, is the color of most displays. Jeff Peacock

Why is emerald alone absent from the universe's sextillion suns? Elementary, my dear Flanagan. Green lies smack in the middle of the visible spectrum. To dominate, it needs to overpower the other colors, which would require a star with both the hot (blue) and the cool (red) ends of its spectrum simultaneously suppressed. Or the green would have to result from an Irish stew of emissions — tricky, because just as in TV tubes or stage lights (not paint pigments), green is one of the three primary colors of light and can't be created by mixing.

Here's the bottom line: A star appears a particular hue not because it's emitting only that color or even mostly that color. It's often simply the result of diverse colors being scrambled together. Something appearing egg-yolk yellow may either emit yellow light or a combination of red and green. Purple is a mixture of red and blue.

A spectroscope reveals a star's true colors. When all the hues are equally intense, the star looks white. Unequal emissions brew up different results, and often it's a surprise. For example, common mercury-vapor streetlights and backyard "yard lights" look blue-white, despite emitting no blue light whatsoever. A handheld spectroscope shows that they put out just three precise colors: violet, green, and mustard. Yet, these colored emissions combine to yield a blue-white hue to the eye. Unfortunately for the Irish, no star radiates wavelengths that, when blended, produce a green hue.

Rigel and Spica come closer to reality; they're listed as "blue" and are really blue-white, closely matching those mercury street lamps. An actual sky-blue star would look amazing, but none is known to exist. Does color desperation drive authors to exaggerate? Is the night not colorful enough? Or do we lack visual subtlety?

At night, the polychrome world becomes monochrome because in low-light conditions the color receptors in the retina — the cones — rest. The rods remain awake, so our low-light world is mostly black and white or shades of gray — or, as many have noticed, greenish-gray.

While it is supposedly yellow, Capella actually is a slightly warm white — what decorators call eggshell. Our sun is commonly thought of as yellowish, despite astronauts' consistent reports that it is a dazzling snow white. It's ironic that no star offers even a hint of green, because our eyes are most sensitive to greenish-yellow light at 5500 angstroms and falls off at shorter and longer wavelengths.

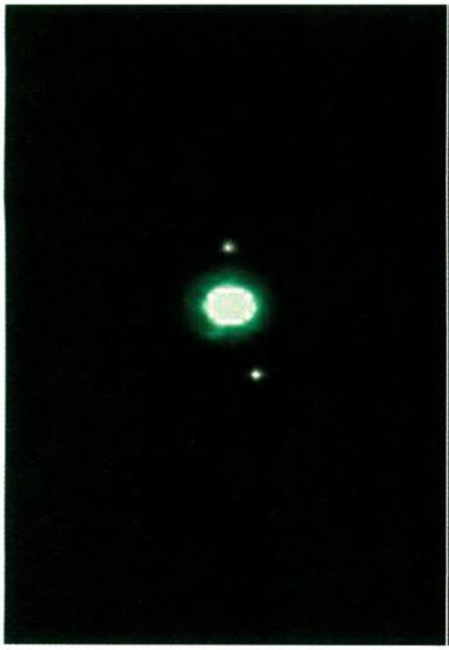
For a quick demonstration of how easily we can perceive even the slightest hint of the shamrock hue, look west these nights to the O'Ryan Nebula, also called M42. With anything bigger than an 8-inch scope, the gas cloud looks pale gray-green. Through larger instruments, Orion's lime becomes increasingly obvious. Yet in a long-exposure photo, reds and blues predominate and the green practically vanishes.

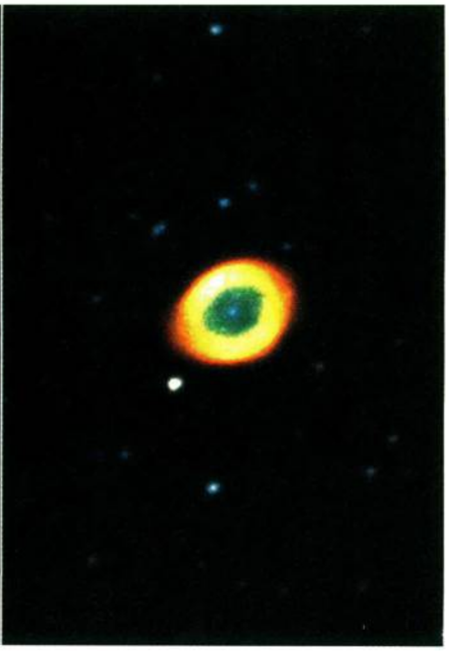
What magic is this? Not a leprechaun at work, but simply color films that are very sensitive to red light emitted by the nebula's hydrogen. Color films are much less responsive to the green emissions near 5000 angstroms. For the eye, it's reversed: We see poorly at the red and violet edges of the visible spectrum. To our eyes, green is visible even at low levels of illumination. The next time you set up your scope in dim, fading twilight, note that the grass remains green while a red car seems murky and colorless.

This visual insensitivity to the extremes of the visible spectrum explains why backyard astronomers can't find red or blue deep-space objects, even though the universe is awash in crimson emission gases and blue reflection nebulae. Only those with telescopes bigger than 16 inches that take time-exposure astrophotographs or create digital images can obtain hints of those hues.

Actually, any kind of saturated color is rare beyond Earth. Nebulae brimming with vivid hues in astrophotos would look washed out "in person." Because of low surface brightness, even relatively vivid gas clouds, such as the Orion Nebula, would display only pale pigments to visiting astronauts. So, you should regard the viewing of any nonstellar color in the night sky as a triumph. When you fire the retina's cones at an eyepiece at night, the color you'll usually see is green. (Suddenly it starts to look as if the Irish haven't been cheated, after all).

Fortunately for the Irish, there are plenty of other places, aside from stars, to search for emeralds. It's a simple matter of changing one's focus: a forest of green lurks closer and farther from home. When it comes to the solar system, most planets have no obvious visual pigment. With Venus, Saturn, Jupiter, and Pluto, it's a case of the bland leading the bland. There's no distinct color to any of them, just warmer or cooler shades of white. (Jupiter does have a pale pink "Great Red Spot" and





Left: Uranus looks greenish, unlike any star. Satellites Titania, above, and Oberon, below, also appear in this image. John Chumack

Right: The central region of the Ring Nebula (M57) has a greenish hue. John Chumack

The Eye's Attraction to Green

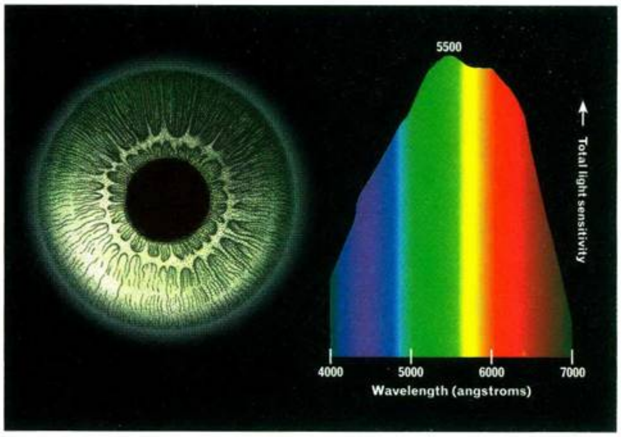
In our pursuit of green, or any color for that matter, let's shatter a couple myths. First, visible light actually has no color. The sensation of color is created in the mind – not in the physical world. A given wavelength of light, seen in isolation in the dark, creates a mental image of that color, and the color spectrum is merely symbolic of the different wavelengths we sense.

In addition, the notion that the eye can distinguish from a myriad of different hues is fiction. This idea has often been repeated in recent years, since only in the last decade have home computers been able to display more than a million discrete colors on monitors. I've heard computer experts claim that the eye/brain/retina system constitutes "an amazing device that can discriminate between closely adjacent colors to readily perceive at least several hundred thousand hues, if not millions."

Beep! Wrong!

The best the eye can do is distinguish between wavelengths separated by 10 angstroms. And it's most sensitive in the (you guessed it) green part of the spectrum. When it comes to reds or violets, the acumen is only a tenth that great. So in the green kingdom (between 5000 and 5500 angstroms), human vision can detect about 50 hues. There are about four dozen possible "stops" on the railroad line from where yellow has the first detectable green tinge to where aquamarine becomes more blue than green. All colors considered, we can see no more than a few hundred monochromatic hues. Not thousands or hundreds of thousands, let alone millions.

The test for true color sensitivity is usually performed at a split screen, with slightly different wavelengths displayed on each half. With less than nine angstroms difference, the observer will report a unity of appearance. As different hues are presented, a critical point arrives where separate colors are sensed: the screen suddenly seems divided in two.



We're speaking strictly about colors, not the twiddling with other properties, such as shades (the relative darkness of a color), tints (the relative lightness of a color), or color saturation (reducing the full intensity of a base color by adding black or other colors). Throw these color permutations into the equation and we do have thousands of discernable possibilities in the kingdom of green alone.

Some of us do poorly in separating colors because we possess large individual differences in our ability to discriminate between closely matched hues. We also vary in our ability to see deep into the red and violet edges of the spectrum. But few people, except those with a specific form of color blindness called deuteranopia, fail to perceive green. – *B. B.*

a warm off-white overall appearance, but not the splendiferous colors of tweaked photographs.)

A few planets, however, boast decisive color: Neptune looks pale blue, Mars appears orange, and Uranus is the cosmic Erin. Its unambiguous green hue is obvious through any telescope, and the quickest way to spot Uranus in a crowded star field.

Green is also the standout hue of planetary nebulae seen visually at the eyepiece. Many of these, such as the famous Ring Nebula (M57) in Lyra, seem spooky gray through medium-size instruments. However, when viewed with larger scopes it is vivid green. Some planetaries, such as NGC 6543 in Draco, appear intensely green even through small or medium telescopes. While red dominates the cosmic color palette because of its 6563-angstrom hydrogen emission, a little bit of nebula-sweeping shows us that, for direct human vision, green is the most intense, common, and easily seen color in the cosmos. The hue's absence among stars seems to have been compensated by its omnipresence everywhere else, especially the gas clouds woven through the night.

Bright meteors, too, often put some Irish on the whizzing stones by displaying a vivid green that appears as in-your-face as a traffic light. These essentially display the "flame test" of the component elements.

We will collide with the biggest curtain of green this year — the aurora borealis. The pale patterns ebb and flow with the sun's 11-year storm cycle, whose maximum is upon us. It's a safe bet that Canada and the northern half of the United States will be treated to several bright displays. The southern latitudes may even get in on the act if we get a repeat performance of the March 13, 1989, spectacle (during the last sunspot maximum). That night the northern lights illuminated skies all the way to Mexico. Those lucky enough to have caught the spectacle reported intense color that went vividly beyond the pastel. Like most aurorae, the most common shade that night was whitish green light, coming from emissions of atomic oxygen at 5577 angstroms (the green line). Less commonly a deep ruby red light (the red line at 6300 angstroms) also beautifully materializes, similarly generated by atomic oxygen's nervous electrons.

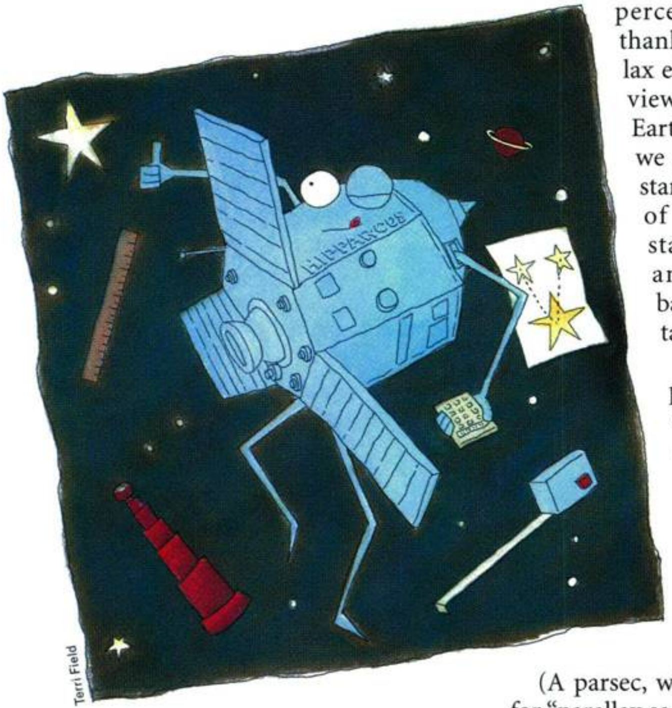
So it appears that when 2001's nocturnal heavens are painted, the color will be green. Can the sunspot maximum falling on the millennium be simply accidental? Since the cosmos has apparently decided to participate in our calendar celebration, the conclusion is inescapable.

The universe has an Irish accent. ■

Frequent contributor Bob Berman's latest book is Cosmic Adventure.

ask Astro

Parallax, Blueshift, Terrestrial Water, Jupiter



Terri Field

How do astronomers estimate the distances to nearby stars? — *Annette Patton, Philomath, Oregon*

Though the principles behind distance measurements in astronomy are simple, their application surely is not. The basic idea begins with something called trigonometric parallax — the apparent angular displacement of an object's position when viewed from two different locations. Whenever you look at an object, whether a star or your coffee cup, from two different directions, it seems to shift position. And the more distant that object is, the less pronounced the shift will be.

As it turns out, parallax is very important to humans: It lays the foundation for three-dimensional vision and allows humans to adequately perceive depth. Moreover, thanks to large-scale parallax effects, we also have 3-D views of star positions. As Earth goes around the sun, we continually look at the stars from different points of view, and the nearer stars seem to shift back and forth against the background of more distant stars.

Now, here's the punchline. If we can accurately measure the angle through which a star seems to shift, we can obtain its distance. The distance, measured in parsecs, is the inverse of the parallax angle, measured in arcseconds. (A parsec, which is an abbreviation for "parallax second," equals 3.26 light-years. One arcsecond is 1/3600th of a degree). By definition, Earth's orbit appears to be one arcsecond across from a distance of one parsec.

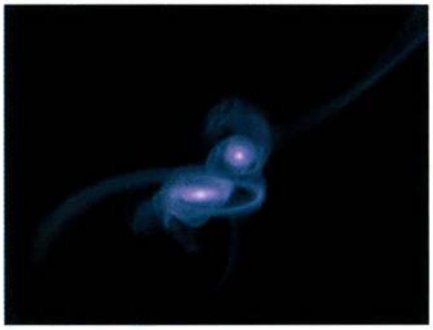
The difficulty with using parallax to obtain stellar distances is that typical parallax angles are tiny and not resolved by the naked eye. In fact, it is such a subtle effect that stellar parallaxes were not detected until 1837. The parallax for the sun's nearest neighbor, Alpha Centauri (discounting its slightly closer faint companion Proxima), is only 0.74 arcsecond, or a mere 0.00021 of a degree, the angular size of a U.S. penny seen 3 miles away. Using the inverse relation, we know that Alpha Centauri is 1.35 parsecs, or 4.4 light-years, away.

In the past decade, our ability to accurately determine distances has experienced a huge leap forward with data from the Hipparcos satellite. Avoiding the blurring effects of Earth's atmosphere, Hipparcos has measured parallax angles with a precision better than a thousandth of an arcsecond — a penny at Los Angeles seen from New York. Consequently, we've successfully measured stellar distances to 1,000 light-years or more. — *Jim Kaler, University of Illinois. Visit the "Star of the Week" on his website at www.astro.uiuc.edu/~kaler/sow/sow.html*

I often read about redshift, but rarely blueshift. Out of countless stars and galaxies visible from Earth, aren't any of them moving toward us? — *Andy Brown, New York, New York*

The term redshift is commonly used to describe galaxies with spectra that are shifted toward longer wavelength, i.e., to the red. This is because most galaxies appear to be moving away from us due to the expansion of the universe. Within our own galaxy, however, there is no such preferred motion because the Milky Way is rotating rather than expanding. Depending on where a star is, it will appear to be moving away from us (redshifted) or just as likely toward us (blueshifted). In fact, many

Dying to meet: A supercomputer simulation sneaks a peek at the Milky Way and Andromeda galaxies before and after their expected collision in 3 billion years. John Dubinski/SDSC



of the closest stars are moving toward us at very high speeds.

Although the light from most galaxies appears to be redshifted, several galaxies are blueshifted and moving toward us. For example, the Andromeda Galaxy (M31), our closest large spiral galaxy neighbor at 2.4 million light-years, is moving toward the Milky Way. What's more, some dynamical models suggest that M31 will merge with the Milky Way in about 3 billion years.

We also see blueshifted galaxies all the way out to the Virgo Cluster almost 40 times as far away as M31. These galaxies are sufficiently close that their motions within the cluster are larger than the expansion velocity of the cluster. But beyond the Virgo Cluster, every object in the universe appears to be redshifted, and thus moving away. — *Chris Conselice, Space Telescope Science Institute*

Where did all the water that makes up Earth's oceans come from? — *Ivan Brajdic, Perth, Australia*

This is a good question. In fact, it's been a major research question for the last few years. A partial answer is that water vapor was expelled from Earth's interior during volcanic eruptions and was added to the atmosphere where it condensed and fell as rain, ultimately forming the oceans we see today. But one key question remains unanswered: From where did the water molecules in Earth's interior originate?

Scientists have proposed at least two competing theories for how a primordial Earth became rich with water vapor. One idea is that the planetesimal bodies that came together to make up Earth already contained water. Another idea suggests that most of the water came to Earth after it formed, as Earth was pelted by ice-rich comets.

One argument against the idea of water being present since the formation of Earth is that the planetesimals that formed Earth were too close to the sun to contain ice or water. If this was the case, then Earth would have formed dry. Nonetheless, this theory recently gained some serious support. In August of 1999, scientists in Houston and Virginia found that a stony meteorite, very similar to the type from which Earth may have formed, contained tiny amounts of water. And the theory gained still more support in September of 1999, when a U.S.-Australian team provided evidence that Earth's mantle contains a reservoir of primordial gases that could include water vapor.

NASA

Earth still harbors many secrets, including the origin of her vast, life-giving waters.

Many scientists hope to test these theories further by measuring the proportions of isotopes making up the water and other primordial gases of Earth. Water from comets has different isotopic chemistry than water from meteorites and other parts of the solar system. Thus, it may be possible to measure the "isotopic fingerprint" of Earth's water to determine where it came from with absolute certainty. — *William K. Hartmann, Planetary Science Institute*

I've heard that if Jupiter were a little more massive, it would have ignited to become a star. How much more massive? Would Earth still be habitable? — *Jake Stawoney, Crestwood, Illinois*

I'm always amused by the claim that if Jupiter were just "a little" more massive, it would have become hot enough to sustain the same nuclear reactions that power the sun. In fact, Jupiter would have to be a whopping 80 times more massive to fuel nuclear fusion at its core. In like fashion, if I were just "a little" richer, I'd be a millionaire.

If Jupiter had indeed been born this massive, we'd see a red star shining nearly as brightly as the moon. At some times during the year, this red star would appear at night, and at other times during the day. But the extra light wouldn't hurt life on Earth — that is except for us peculiar life forms known as astronomers. Its glare would wash out dim celestial objects, making our jobs very difficult.

The real trouble with the existence of a much more massive Jupiter is that it might have kept Earth from forming. The Jupiter we know today was bad enough: look what its gravity did to the planet that tried to form between itself and Mars. It was torn to shreds, forming what we now call the Asteroid Belt. If Jupiter had been born 80 times more massive, its gravity might have reduced Earth to asteroid rubble. So be glad that Jupiter is only a planet and not a star. — *Ken Croswell, author of* See the Stars *(Boyds Mills Press, 2000). Check out his website at www.ccnet.com/~galaxy* A

CONTACT INFO

Send your questions via e-mail to: askastro@astronomy.com; or write to: Ask Astro, P.O. Box 1612, Waukesha, WI 53187. Please tell us your full name and where you live.

ORION
TELESCOPES & BINOCULARS

Hundreds more products online!
telescope.com

Our 26th Year!

TELESCOPES

Orion SkyQuest™ XT Dobsonian Telescopes
Big Aperture, Superior Performance, Point-and-View Simplicity

For a fraction of the cost of a little "go to" scope, you can own a telescope with serious *aperture*. See more of the universe—for less—with an award-winning SkyQuest XT metal-tube Dobsonian. It'll keep you up nights.

ENAMELED STEEL TUBE, NOT CARDBOARD!
New!
New!
SkyQuest
SkyQuest
SkyQuest
SkyQuest

SkyQuest XT4.5
Just the right size for younger stargazers, and incredibly easy to master! Adults will love it too, for its portability and crisp optical performance.
Steel tube, 114mm mirror (f.l. 910mm, f/8), 1.25" R&P focuser, 6x30 achromatic finder scope, 25mm (36x) and 9mm (110x) Plössl eyepieces (1.25"), 5" flanged altitude hubs, CorrecTension Friction Optimization, built-in handle, dust cap. Weight: tube 9 lbs., base 8-1/2 lbs.

$229

SkyQuest XT6
The overachieving XT6 will show Jupiter's Red Spot, Saturn's Cassini Division, hundreds of clusters and nebulas, and galaxies tens of millions of light-years distant. Nicely portable and very affordable!
Steel tube, 152mm parabolic mirror (f.l. 1200mm, f/8), 1.25" aluminum R&P focuser, 6x30 achromatic finder scope, 25mm (48x) and 9mm (133x) Plössl eyepieces (1.25"), Moon filter, eyepiece rack, 5" flanged altitude hubs, CorrecTension Friction Optimization, dust cap. Weight: tube 13 lbs., base 24 lbs.

$369

SkyQuest XT8
The XT8's prodigious performance on both solar system and deep-sky denizens have made it the telescope of choice for thousands of astronomers, from beginners to die-hard hobbyists.
Steel tube, 200mm parabolic mirror (f.l. 1200mm, f/6), 1.25" aluminum R&P focuser, 6x30 achromatic finder scope, 25mm (48x) and 9mm (133x) Plössl eyepieces (1.25"), Moon filter, eyepiece rack, 5" flanged altitude hubs, CorrecTension Friction Optimization, dust cap. Weight: tube 19 lbs., base 23 lbs.

$499

SkyQuest XT10
Gulping in over 50% more light than an 8" scope, the XT10 reaches far deeper into space. The sheer number of objects visible in this scope is staggering, and its resolving power brings out detail that will keep you entranced for years.
Steel tube, 250mm parabolic mirror (f.l. 1255mm, f/5), 2" aluminum R&P focuser, big 8x50 achromatic finder scope, 25mm (50x) and 9mm (139x) Plössl eyepieces (1.25"), Moon filter, eyepiece rack, 5" flanged altitude hubs, CorrecTension Friction Optimization, dust cap. Weight: tube 35 lbs., base 23 lbs.

$649

Orion VX114-ED f/5.3 Apo Refractor

An exciting, compact scope that excels for both wide-field visual and astrophotographic applications. Features a 114mm (4.5") two-element ED-glass objective lens (f.l. 600mm, f/5.3) plus additional field flattener for exceptional image quality. Features a 2" aluminum focuser with 1.25" visual back, 7x50 finder scope with dovetail bracket, hinged tube rings and handle, and adapter plate for GP/GP-DX mounts. Eyepiece and diagonal not included. Available as tube assembly only or with GP or GP-DX mount. Electronic drives and controller or SkySensor Go-To system sold separately. Made in Japan.

$2199 (Tube assembly)
$2889 on GP Mount
$3299 on GP-DX Mount

Shown with GP-DX mount, Short Tube 80 as guide scope, and photographic accessories.

Orion SpaceProbe™ 130ST EQ Reflector

The niftiest equatorial reflector we've seen in a long time! The 130"ST" (for short tube) features a 130mm (5.1") *parabolic* mirror of 650mm focal length (f/5), yielding a wide field of view and bright, sharply focused images. The secondary mirror holder has thin 0.5mm metal vanes to reduce diffraction spikes and light loss. The optical tube measures just 24" long, for great portability. Includes EQ-2 mount with aluminum tripod, 6x30 finder scope, and 25mm (26x) and 10mm (65x) Plössl eyepieces.

Only **$349**

Orion SkyView™ Deluxe EQ Series
Telescopes for *Today's* Amateur Astronomer

SkyView™ Deluxe 8 EQ Newtonian
A deep-sky lover's delight! Big, diffraction-limited 200mm parabolic primary mirror of 800mm focal length (f/4) delivers vivid, wide-field views of nebulas, clusters, and galaxies. Gathers 73% more light than a 6" scope, yet is nicely portable. Enameled steel tube and aluminum R&P focuser (1.25").

$649

SkyView™ Deluxe 6 EQ Newtonian
Outstanding for deep-sky and planetary/lunar study. Features a precision 6"-diameter **parabolic** primary mirror and aluminum R&P focuser. Enameled steel optical tube. Focal length 750mm (f/5).

$499

SkyView™ Deluxe 4.5 EQ Newtonian
An exquisite combination of form, function, and affordability for the serious beginning astronomer. The rolled steel optical tube houses a precision-polished 4.5" primary mirror of 920mm focal length (f/8).

$379

SkyView™ Deluxe 90mm EQ Refractor
Exceptionally crisp views of the Moon, planets, and beyond! Multi-coated 90mm achromatic objective lens of 1000mm focal length (f/11.1). Seamless aluminum optical tube.

$399

Electronic Drive Compatible!

Look What's Included
- *New heavy-duty EQ mount*
- *TWO 1.25" Plössl eyepieces*
- *6x30 achromatic finder scope*
- *Moon filter (1.25")*
- *Gold-anodized aluminum tripod*

FREE!
A $49.95 Value!
Polar-Alignment Scope

Outfit your SkyView Deluxe with an AccuTrack™ Electronic Drive for automatic star tracking.

Was $77 now **$64.95**

MONEY-BACK GUARANTEE
100% Satisfaction
If you are not completely satisfied with your purchase from Orion Telescopes & Binoculars for any reason, just return it in new condition within 30 days after delivery for a prompt refund.

Visit our California Retail Store!

San Jose-Cupertino • 10555 S. De Anza Blvd., at McClellan: from Hwy 280, take De Anza exit; from Hwy 85 take De Anza or Stevens Creek exit • (408) 255-8770

Prices are subject to correction or change without notice.

24 Hour Toll-Free Orders: (800) 447-1001
Information/Advice: (800) 676-1343
Information Line Hours: M–F 6am–8pm, Sat. 8am–6pm Pacific Time

telescope.com

BINOCULARS

NEW! 12X50!

Scenix™ 50mm

Newly upgraded with BAK-4 prisms for improved images. Multi-coated optics. Metal housing, not plastic. Tripod adaptable.

7x50 7.1° field	$77.50
10x50 WA 7.0° field	$77.50
12x50 WA 6.0° field	$77.50

LONG EYE RELIEF!

UltraView™ 50mm

Extra-long 22mm eye relief makes these superb for eyeglass wearers! Fully multi-coated optics, BAK-4 prisms. New twist-lock eyecups. Tripod adaptable.

7x50 6.5° field	$159
10x50 WA 6.5° field	$159

FULLY MULTI-COATED OPTICS!

Vista™ 50mm

Featherlight High-Performance Binoculars. High-index BAK-4 prisms and fully multi-coated optics for high-fidelity images. Soft leatherette covering. Tripod adaptable.

7x50 6.0° field	$199
10x50 WA 5.3° field	$199

LONG EYE RELIEF!

Mini Giant™ Binos

Compact astro binocs that show you the light! Fully multi-coated optics, BAK-4 prisms. Long eye relief (8x56: 18mm, 9x63: 26mm). Easily hand-holdable, but also tripod adaptable.

8x56 5.8° field	$159
9x63 5.0° field	$189

TRIPOD L-ADAPTER INCLUDED!

Giant 80mm

Stunning resolution of clusters, nebulas, and lunar surface detail. Fully multi-coated optics with BAK-4 prisms. Objective bridge for added rigidity. Center focus. Tripod L-adapter included. Long 15mm-16mm eye relief.

11x80 4.5° field	$388
16x80 3.5° field	$388
20x80 3.5° field	$388

TRIPOD L-ADAPTER INCLUDED!

Little Giant™ II 70mm Binocular

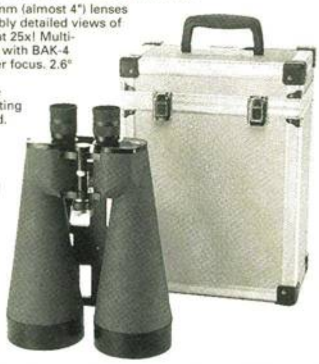
More compact than the original Little Giants. Big 70mm objectives reveal a plethora of nebulous clouds and stellar clusterings. Great for twilight and daytime use too. Sharp, fully multi-coated optics with BAK-4 prisms. Large, knurled center focus wheel. Classic black coarse-grain finish. Tripod L-adapter, case, and deluxe wide neck strap included. Made in Japan.

11x70 4.5° field	$259
15x70 4.0° field	$259
20x70 3.0° field	$259

SuperGiant™ 25x100mm

Gigantic 100mm (almost 4") lenses for unbelievably detailed views of the heavens at 25x! Multi-coated optics with BAK-4 prisms. Center focus. 2.6° field of view. Platform-type 1/4"-20 mounting plate included. Comes with foam-lined aluminum case.

$1149



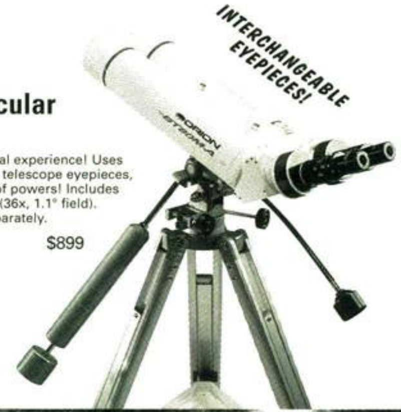
INTERCHANGEABLE EYEPIECES!

80mm Binocular Telescope

An unforgettable visual experience! Uses interchangeable 1.25" telescope eyepieces, allowing wide range of powers! Includes two 25mm eyepieces (36x, 1.1° field). Mount/tripod sold separately.

$899

Custom D Altaz Mount/Tripod
Shown here.
$449



EYEPIECES & ACCESSORIES

Sirius™ Plössl Eyepieces

You could pay twice the price for other brands of Plössl eyepieces, but why? Sirius Plössls are top-quality, 50° apparent-field (43° 40mm) eyepieces that yield extremely sharp images of impressively high contrast. Ideal for all types of telescopes. Fully-coated optics, rubber eyeguards.

1.25"

6.3mm, 7.5mm, 10mm, 12.5mm, 17mm, 20mm, 26mm	$49.95 each
32mm, 40mm	$59.95 each

.965" **Sale!**

6.3mm, 7.5mm, 10mm, 12.5mm, 17mm, 20mm, 26mm	~~$49.95~~ $39.95 each

Orion Lanthanum Eyepieces

Our rare-earth lanthanum eyepieces have new chrome exteriors but the same superior image correction and generous 20mm eye relief of the previous models. Ideal for eyeglass wearers! Fully multi-coated optics with six to eight lens elements. Apparent field 50° (7.5-25mm), 45° (2.3mm-5.2mm). Pop-down rubber eyecups. Made in Japan. 1.25" barrels.

3.8mm, 5.2mm, 7.5mm, 9.5mm, 10.5mm, 12.5mm, 14mm	$109 each
2.3mm, 18mm, 21mm, 25mm	$119 each

Save Big on Sirius Sets!

Need More Than One?

Save on these practical Sirius Plössl sets. (You save on shipping, too!) 1.25" barrel diameter only.

Sirius Plössl Starter Set

And ideal "upgrade" set to replace lower-quality eyepieces, it includes three must-have focal lengths for low-, medium-, and high-power viewing: 26mm, 17mm, and 10mm.

Reg. $149 Set Price **$119**

Sirius Plössl Expansion Set

If you already have the Starter Set, or the 25mm and 10mm eyepieces included with many telescopes, this set provides three complementary focal lengths for medium and high magnifications: 20mm, 12.5mm, 7.5mm.

Reg. $149 Set Price **$119**

Sirius Plössl Power Pair

For planetary and lunar viewing especially, these 12.5mm and 7.5mm high-power oculars will have you discovering new detail. Even if you already use a 9mm or 10mm eyepiece, get this pair to add more magnification options.

Reg. $100 Set Price **$79.90**

Lanthanum 65° Superwides

Combining long 20mm eye relief, an expansive 65° apparent field, and a rare-earth lanthanum lens element for superior image correction, these oculars are an astronomer's dream come true. Eight lens elements, multi-coated. Fit 1.25" or 2" focusers.

3.5mm, 5mm, 8mm, 13mm	$214 each
17mm, 22mm	$222 each
42mm (2" only)	$319 each

Padded Scope Cases

Protect your investment with a padded, polyester/nylon case. Strap handles for easy carrying. Many sizes.

From $29.95

Orion LaserMate™ Collimator

Align your Newtonian's optics to get the best possible images. This compact laser collimator removes the guesswork, making the procedure quick and extremely precise. Just 3-1/3" long!

Only $69.95

DANGER
LASER RADIATION
AVOID DIRECT EYE EXPOSURE
LASER DIODE
<5mW PWR. OUTPUT, WAVELENGTH: 630-680nm
CLASS IIIA LASER PRODUCT

Aluminum Accessory Cases

Rugged and classy looking. Pre-cut, cubed foam inside to fit your specific accessories. Ample room for giant eyepieces, camera body, lots of stuff!

Medium Case	$29.95
Large Case	$44.95

Orion EZ Finder™

Illuminated "red dot" in nonmagnified 9° field of view shows right where telescope is pointed. Adjustable brightness. Attaches to any telescope.

$39.95

SkyGlow™ Broadband LP Filters

Improves contrast of all objects in moderately light-polluted skies.

.965" $39.95,
1.25" $59.95,
2" $109, SCT Rear Cell $79.95

UltraBlock™ LP Filters

Maximum contrast enhancement for emission nebulas.

.965" $59.95, 1.25" $99.95
2" $139, SCT Rear Cell $129

New!

Orion Tri-Mag™ 3x Barlow

Need more magnification for higher-power viewing or guiding? The Tri-Mag gives a 3x power boost to any 1.25" eyepiece. Great for lunar and planetary observing and low f-ratio telescopes. Use longer-focal-length eyepieces and enjoy better edge sharpness and eye relief than with equivalent short-focal-length eyepiece. Multi-coated optics in anodized aluminum barrel. Threaded for filters. Length, 5".

$44.95

Hundreds of products in our print and online catalogs!

ORION
Stellar Escapes
telescope.com

ORION
TELESCOPES & BINOCULARS
P.O. BOX 1815-A, SANTA CRUZ, CA 95061

telescope.com

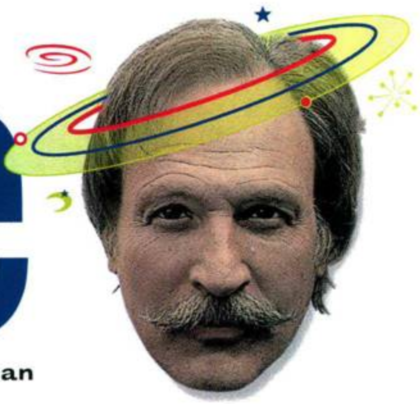
IT'S EASY TO ORDER!

- Call toll-free and charge to your Discover/Novus, MasterCard, or VISA Card, or send your personal check to order by mail. Mail Orders to: P. O. Box 1815-A, Santa Cruz, CA 95061-1815. Fax Orders to: (831) 763-7024.
- California residents add 7% sales tax (8% in Santa Clara County; 7.75% in Santa Cruz County; 8.25% in San Francisco).
- Shipping and handling charges additional. Call for rates. Delivery in U.S. and Canada only. Expedited delivery available.
- Prices are subject to correction or change without notice.

FREE 100-PAGE CATALOG
CALL (800) 447-1001

When ordering, mention key code UMA

strange Universe



by Bob Berman

Alien Planet

You'd think everyone could identify Venus. For backyard astronomers, recognition is automatic; it's as challenging as locating the moon. Yet most people are clueless about that dazzling "star" — some even grab the phone and report an Unidentified Flying Object.

Jimmy Carter did, while governor of Georgia. The Evening Star's brilliance so puzzled and concerned him that he alerted the State Police. And in World War II, a squadron of B-29s returning from a mission over Japan grew increasingly anxious about a bright light that seemed to follow them. They turned around and tried, unsuccessfully, to shoot down Venus.

Some years back, a survey named Venus as the single most common cause of UFO reports. Size-for-size, its light is far more intense and concentrated than moonlight, especially when at its very brightest, as it is now during late February and early March. Its steady, non-twinkling glow makes it seem eerily unstarlike.

Moreover, when the Evening Star reaches peak brilliance in late winter as it does this year, it remains out long after twilight, setting its dazzle against a black sky for an even more theatrical effect.

Police stations can count on "alien spacecraft" calls at this time of year. And some people regard observatories as official UFO Reporting Centers. I've received a couple of reports a month during peak-Venus periods, though my neighborhood probably gets more reports than most; it includes the flashback-prone Woodstock region.

People have interesting reactions when their UFO sighting has been resolved. Many are excited to know that they've seen our neighboring planet, and they appreciate having their curiosity so decisively satisfied. But others sound disappointed. They seem to want to be invaded by aliens. Still others have heard of UFOs for decades and wish to amuse themselves by seeing an unambiguous example of extraterrestrial tourism.

When I lecture to astronomy groups — my favorite audiences — I usually ask how many have ever seen a UFO. I've continuously added to my informal survey, satisfying my bias that those who know the sky never encounter such things. To be honest, however, a couple of people in every group of 40 or 50 do report having viewed mystery lights. I once assumed that these were novices who hadn't yet seen things like bolides (exploding meteors) dramatically blowing themselves to bits. But no, many backyard astronomers give straightforward accounts of lights performing zigzags or other impossible aerobatics, sightings that seem to preclude all natural explanation.

It seems arrogant to dismiss some of these stories by sober and intelligent people. Yet I've been watching the skies for 40 years, and as an airplane owner I also do a fair amount of night flying, and I've never seen a UFO. Moreover, I've often witnessed high UFO-sensitivity, as when students excitedly point at a satellite or plane and nervously yell, "What the heck is that?"

To me, the best case against UFOs is that very few knowledgeable amateur astronomers who keep the heavens under nightly observation ever see such things. It also seems suspicious to me that these aliens are smart enough to get all the way here from Epsilon Eridani but wish to remain anonymous (since they're not landing on the White House lawn or even at the Green Party headquarters). Still they keep getting caught by earthbound viewers like incompetent cat burglars. And nobody ever catches them on a clear, focused videotape.

Then there are the hoaxes and pranks. A group of pilots from nearby Stormville Airport, here in rural upstate New York, admitted that they sometimes flew in formation at night with lights blazing, just because they loved to read the UFO reports in the paper the next day. Who knows how many other playful types are into such UFO mischief?

Though not an alien spacecraft, Venus still manages to do amazing things. For starters, it now briefly joins the sun and moon as the only natural objects that can cast shadows. It also joins the elite club of the moon and Mercury as the only celestial objects that assume crescent shapes to our eyes. (Venus's crescent gets absolutely fabulous during March, especially when viewed in twilight.) But its strangest feature may simply be that from *around March 24 to March 29, it* can be easily viewed as both a morning and evening star simultaneously. This is a trick it only performs once in each of its eight-year repertory cycles. Venus goes around the sun 13 times while Earth simultaneously makes eight circuits, so these venusian shenanigans repeat almost precisely every eight years.

In late March, then, Venus will readily appear just above the western horizon immediately after sunset, but also materialize in the eastern sky right before sunrise. It seems to be on both sides of the sun at the same time.

This nifty maneuver arises because Venus will scoot quite a bit north of the sun at inferior conjunction on March 30, letting it set later and rise earlier for Northern Hemisphere observers than the more southerly-sited sun. In just another three years, Venus will pass directly in front of the sun for the first time since 1882, visible from the eastern United States and Europe. I've been waiting for this transit of Venus since I was a kid (despite that I know it'll be cloudy in New York that morning.)

That's just two inferior conjunctions away. This time, Venus misses the sun by quite a bit, which allows anyone with a setting-circle or computer-guided telescope to view Venus by day, continually, as it crosses over to become a morning star.

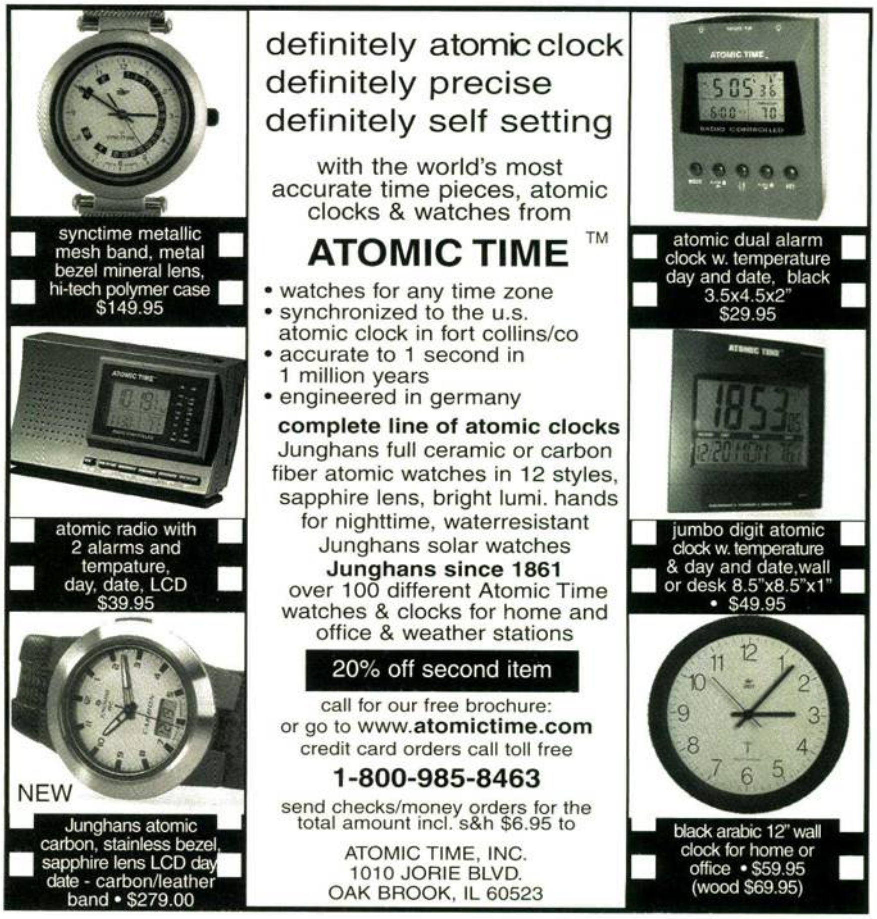
(Be careful. Don't "sweep" your scope near the sun while looking for it. You don't want to get a blast of full sunlight through the eyepiece, like I once stupidly did.)

During the last week of March, Venus will not only be at its most visible and its skinniest, but it may display for you its mythical ashen light — an eerie glow that diffuses through its clouds to illuminate some of its dark hemisphere.

Venus is fabulously strange, even if it isn't a UFO.

Maybe observatories can simply play a recorded message that says that dazzling light is not from another planet. It is another planet. **A**

Bob Berman, a rural New Yorker, is a regular contributor to Astronomy *magazine. He also teaches astronomy classes, directs a planetarium, and writes books, including* Secrets of the Night Sky.



definitely atomic clock
definitely precise
definitely self setting

with the world's most accurate time pieces, atomic clocks & watches from

ATOMIC TIME ™

- watches for any time zone
- synchronized to the u.s. atomic clock in fort collins/co
- accurate to 1 second in 1 million years
- engineered in germany

complete line of atomic clocks
Junghans full ceramic or carbon fiber atomic watches in 12 styles, sapphire lens, bright lumi. hands for nighttime, waterresistant
Junghans solar watches
Junghans since 1861
over 100 different Atomic Time watches & clocks for home and office & weather stations

20% off second item

call for our free brochure:
or go to www.**atomictime.com**
credit card orders call toll free
1-800-985-8463
send checks/money orders for the total amount incl. s&h $6.95 to

ATOMIC TIME, INC.
1010 JORIE BLVD.
OAK BROOK, IL 60523

synctime metallic mesh band, metal bezel mineral lens, hi-tech polymer case $149.95

atomic radio with 2 alarms and tempature, day, date, LCD $39.95

NEW
Junghans atomic carbon, stainless bezel, sapphire lens LCD day date - carbon/leather band • $279.00

atomic dual alarm clock w. temperature day and date, black 3.5x4.5x2" $29.95

jumbo digit atomic clock w. temperature & day and date,wall or desk 8.5"x8.5"x1" • $49.95

black arabic 12" wall clock for home or office • $59.95 (wood $69.95)

DISCOVERY
TELESCOPES
2001 CELEBRATES OUR 10TH ANNIVERSARY

TRUSS DESIGNS
PREMIUM DHQ
DHQ
EQ

Ask for a FREE Discovery Catalog showing our complete line of Telescopes, Optics and Accessories
Order online or toll free:
(877) 523-4400
visit our website at:
www.discovery-telescopes.com

Anyone can sell you a telescope.

Authorized Meade Dealer

Meade ETX-90EC **$595**
Meade ETX-125EC **$895**
#497 Autostar **$149**

Hardly a day goes by that we don't get a note or E-mail message like the one reprinted on the next page, or a call that goes something like this: "Your ads are right. Dealer so and so advertises low prices – but they don't have what I want in stock, they couldn't answer *any* of my questions, and they wanted my credit card number before they'd even *talk* to me. They said if I wanted to ask questions, I should call the manufacturer . . . and then they hung up on me!"

If you want the right telescope, you need more than a camera store clerk armed with only a price list and not a clue in the world about astronomy.

What you *really* need are people who will take the time to listen to what *you* need, people who can answer your questions, people with years of experience using and selling telescopes who can help you get the most telescope for your dollar. That's exactly the kind of people you'll find at ***astronomics***.

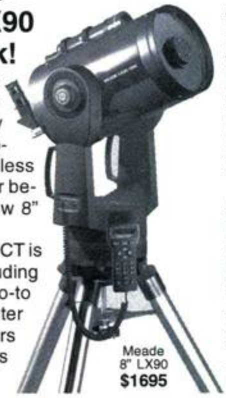
Unlike camera stores and shopping mall gift shops, telescopes are our specialty at ***astronomics***, not just a sideline. We're a family-owned full-line telescope dealer – not just a few toy telescopes stuck off in the corner of some no-help department store, toy store, or gift shop as an afterthought. And, unlike department store clerks, we don't work on commission, so we won't try to sell you more than you need just to pad our paychecks.

We've been helping people choose the right telescope since 1979. We have the experience to help *you* pick the scope that fits your needs . . . *and your budget* . . . from the many Meade, Celestron, TeleVue, Takahashi, and Questar telescopes we stock at discount prices from $99 to $27,995.

And we can usually ship your right telescope right away, since we normally keep over 1000 scopes in stock!

astronomics. No hard sell. No guesswork. Just honest advice, the *right* scope, and a good price. Call us at (405) 364-0858 and find out for yourself.

The new 8" Meade LX90 is in stock!



Meade 8" LX90 **$1695**

You can live the good life of big-aperture fully computerized go-to astronomy for less money than ever before with the new 8" **Meade LX90**.

The 8" LX90 SCT is only $1695, including a tripod and a go-to Autostar computer with 30,223 stars and objects in its data base.

We've been shipping LX90 scopes to delighted customers for months, and more scopes are arriving weekly, so the chances are good you can get an LX90 with little or no delay. While backorders *are* possible on this hot new scope, if Meade is shipping the LX90 for a dealer to keep in stock, chances are good we *have* it in stock.

Meade prices are about the same anywhere you call. So why order a Meade scope or accessory from a dealer who charges your credit card, then makes you wait and wait until he finally gets around to ordering what you want? Not when you can usually get the Meade you want . . . right now . . . at the right price . . . right here at ***astronomics.***

We buy telescopes by the ton . . . literally!

The day before this copy was written, we received 305 cartons from Meade – *3¼ tons* of scopes and accessories in one shipment. Earlier in the same week, we received 9791 pounds of Celestron scopes and accessories in a single shipment – 21 pallets, a full trailer load. We don't know of many dealers – if any – who stock Celestron and Meade products in those quantities . . . *no matter what they claim.* But we do. Telescopes, eyepieces, filters, CCD cameras and autoguiders, dew caps, Barlows, off-axis guiders, illuminated reticle eyepieces, electric focusers, T-adapters, tele-extenders, counterweights – we keep them all in stock.

Super starter scopes.

Left, Meade ETX-60AT, **$299**; *above,* Meade ETX-70AT, **$349**

The new 60mm **Meade ETX-60AT** and 70mm **ETX-70AT** refractors hit a new low in pricing for fully computerized scopes . . . and a new high in value! For less than the cost of many single eyepieces alone, you can have a complete scope – with dual axis motor drives, two eyepieces, built-in go-to computer with 1471 stars and objects in its memory for pushbutton astronomy, and more!

They're ideal as starter scopes, as second scopes for casual astronomy, as vacation scopes, as scopes for the kids. Any way you look at them, these new Meade scopes are winners!

We stock Pentax XL eyepieces.

From 5.2mm to 40mm, we stock all the Pentax wide field (55° to 65°) XL eyepieces. Each has a rotate-to-adjust-the-eye-relief eyecup, ED glass, and a long 20mm eye relief that's perfect for those who wear eyeglasses.

A baby light bucket for spring and summer viewing . . . $159^95.

The **Bushnell Voyager** 4.5" tabletop rich field reflector gives you a wide field of view, plus all the light-gathering power you can get from a tabletop telescope.

The Voyager comes with a shoulder strap for no-hands carrying. Two eyepieces give you powers of 19x and 100x. Its 3-leg tabletop base also mounts on a photo tripod for use in the field. The Voyager is a good scope for the beginning astronomer, as well as a great travel scope for a more experienced observer.

Bushnell 4.5" Voyager **$159^{95}**

We have the Meade ETX-125EC in stock!

Meade 5" ETX-125EC **$895**

We have dozens of **ETX-125EC** 5" Maksutov-Cassegrains in stock, with scheduled shipments arriving regularly. You don't have to wait to get an ETX-125EC from ***astronomics.***

We've sold over 500 of these 5" computerized Meades last year, and 250 of its smaller brother, the 3.5" ETX-90EC. Add in the hundreds of new 60mm and 70mm ETX refractors we sold, and the Meade ETX scopes make up the most popular family of go-to scopes we carry.

And we don't just have ETX scopes in stock. We have Autostar computers, cases, tripods, eyepieces, electric focusers, filters, camera adapters, and more. If it's any of the Meade ETX scopes, or an accessory for a Meade ETX – *or any Meade telescope* – chances are good that we have it in stock.

Over 1,000,000 people a year visit our redesigned and expanded website, now with secure on-line shopping.

www.astronomics.com

3-day air shipping for the cost of shipping by ground!

We ship by UPS three-day air from our centrally-located warehouse to our East and West Coast customers for the same price as regular ground shipping (except for a few big scopes, scope cases, Dobsonians, dewshields, and a few other bulky items). No matter where you live in the 48 continental United States, your order should arrive by the third business day after we ship. UPS can't guarantee 3-day delivery in case of bad weather or during peak seasons, so UPS service guarantees do not apply to this limited time free upgrade if shipments are delayed.

Our free catalog helps you pick the right Meade, Celestron, Questar, Takahashi, or TeleVue scope.

For detailed information on individual products, visit our Web site. Or call us at (405) 364-0858, or e-mail us, for your *free* copy of our catalog AST. It covers all the scopes and accessories we stock – from Apogee, Bushnell, Canon, Celestron, JMI, Lumicon, Meade, Pentax, Questar, Rigel Systems, SBIG, Software Bisque, Takahashi, TeleVue, and more. We'll include our 8-page guide on how to pick the right scope and your discount prices on the 1000+ products we carry. (Sorry, U. S. sales only.) The catalog is yours for only the cost of a one minute phone call. The information we send will make it the most useful minute you'll ever invest in astronomy.

astronomics

Our 22nd year of friendly service, good advice, and money-saving prices.

680 SW 24th Avenue, Norman, OK 73069

Toll-Free Order Line: **(800) 422-7876** Catalogs/Questions/Advice: **(405) 364-0858**

We'll sell you the *right* telescope.

TMB triplet apos!

More and more TMB refractors are in the hands of some very delighted customers of ours, and the buzz about them grows and grows. Visit our website to see the scopes that are the talk of experienced astronomers everywhere.

TMB 80/6	80mm (3.1") f/6 triplet apo	**$1390⁰⁰**
TMB 80/7	80mm (3.1") f/7 triplet apo	**1390⁰⁰**
TMB 100	100mm (4") f/8 triplet apo	**3290⁰⁰**
TMB 105	105mm (4.1") f/6.2 triplet apo	**3290⁰⁰**
TMB 130	130mm (5") f/6 triplet apo	**4990⁰⁰**
TMB 152	152mm (6") f/7.9 triplet apo	**6990⁰⁰**
TMB 175	175mm (7") f/8 triplet apo	**11,990⁰⁰**
TMB 203	203mm (8") f/9 triplet apo	**19,990⁰⁰**
TMB 254	254mm (10") f/9 triplet apo	**39,995⁰⁰**

TeleVue? We keep it in stock.

TeleVue TV-85, in stock, **$1995**

Hardly a week goes by that TeleVue doesn't send us copies of warranty cards filled with the glowing comments written by our customers about the TeleVue scopes they bought from us. But we don't need to be reassured about TeleVue quality. We expect nothing but praise for TeleVue, which is why we stock them in depth.

Pronto, **Ranger**, **TV-85**, **TV-101**, the **TV-102** optical tube, the **Renaissance** – all are built to uncompromisingly high optical and mechanical standards. Their short focal lengths give you an observing flexibility many other scopes lack. Each has the ability to go from very low power wide angle views (as low as 9x in some cases, with a wide 5.7° field) to very high power, all without losing optical quality (one test report said they used an amazing 89x per inch of aperture on TeleVue's least expensive model, the Ranger).

In addition to telescopes, we stock TeleVue eyepieces; Barlows; camera adapters; mounts; Starbeam and Qwik-Point finders, and all other accessories in depth. If it comes from TeleVue, chances are good we have it in stock for immediate shipment.

TeleVue eyepieces, all models in stock

Fuji astro binoculars!

You may have read that comet Hyakutake, among others, was discovered with big 25 x 150mm and 40 x 150mm Fujinon binoculars. There's no guarantee that you'll discover a new comet with a Fujinon 10 x 70mm or 16 x 70mm FMT-SX binocular, but we can guarantee that the 70mm Fujinons are built to the same optical quality standards as the big Fujis. For pricing and full details, see our newly redesigned and expanded website at **www.astronomics.com**.

> I just wanted to let you know that I am very pleased with the service I recently received from you when I ordered a 10" Meade LX200 online that was promptly shipped and delivered. I am most impressed with your new website. In fact, it was the primary reason I purchased from you instead of a local vendor. Your site provided me with a wealth of information (I'm new to astronomy) and helped me make the appropriate decisions. Keep up the good work. Thanks again.
>
> **Customer Quote of the Month #108**

CCD? We carry Apogee LISÄÄ, Meade, and SBIG.

We stock almost all available models of the Apogee LISÄÄ, Meade Pictor, and SBIG CCD cameras, self-guiding cameras, and autoguiders (like the new **Apogee LISÄÄ** 659 x 494 pixel guider or imager to the left and the *self-guiding* 1534 x 1020 pixel **SBIG ST-8E** enhanced blue sensitivity self-guiding imager below). We also carry a wide range of CCD accessories, as well – flip mirror systems, off-axis guiders, color filter wheels, image processing software, and more. Our large inventory means that the chances are good you won't have to wait to get the camera or accessory of your choice. Here are the cameras and guiders we normally keep in stock and their prices.

Apogee LISÄÄ	autoguider or camera	**$1495⁰⁰**
Apogee LISÄÄ	camera	**1395⁰⁰**
Apogee LISÄÄ	color camera	**1395⁰⁰**
Apogee LISÄÄ	megapixel camera	**2595⁰⁰**
Apogee LISÄÄ	megapixel color	**2595⁰⁰**
Apogee LISÄÄ	guider+color	**2690⁰⁰**
Apogee LISÄÄ	guider+megapixel	**3890⁰⁰**
Apogee LISÄÄ	guider+megapixel color	**3890⁰⁰**
Meade 201XT	autoguider	**395⁰⁰**
Meade 208XT	autoguider or camera	**495⁰⁰**
Meade 216XT	16-bit camera	**695⁰⁰**
Meade 416XTE	camera/guider set	**1995⁰⁰**
Meade 1616XTE	camera/guider set	**6495⁰⁰**
SBIG ST-4	autoguider or camera	**890⁰⁰**
SBIG ST-5C	track/accumulate camera	**895⁰⁰**
SBIG ST-237	track/accumulate camera	**1195⁰⁰**
SBIG ST-7E	self-guiding camera	**2950⁰⁰**
SBIG ST-8E	self-guiding camera	**7350⁰⁰**
SBIG ST-9E	self-guiding camera	**3950⁰⁰**
SBIG ST-10E	self-guiding camera	**7695⁰⁰**
SBIG STV	digital video camera/guider	**1595⁰⁰**
SBIG STVD	digital video w/LCD screen	**1995⁰⁰**

Takahashi – another name for premium optics.

While many people swear *at* the long delivery times quoted by some premium refractor manufacturers, most knowledgeable astronomers swear *by* the unsurpassed optical quality and fast delivery of the Takahashi apochromatic refractors we keep in stock.

From the 2.4" **FS-60C** OTA at $829 to the 6" **FS-152** OTA at $8999, we stock Takahashi fluorite apochromatic doublet refractors, mounts, and accessories – so we can deliver scopes *fast*.

Takahashi FSQ-106N OTA (4" f/5), **$3475**, on an EM-2 mount, **$2229**. Also shown is the FS-102 4" f/8 OTA, **$2349** w/o finderscope.

Why wait for 1-3 *years* to get your apo refractor or mount from another manufacturer? You can be usually be viewing through a superb Takahashi apo only a few short days after you order from us. We can also special order larger scopes with 1-3 month delivery times.

We stock complete Takahashi scopes on mounts, as well as apochromatic optical tubes for use on your own mount.

Takahashi FCL-90 ***Sky 90*** OTA (3.5" f/5.6), shown with dew shield retracted, **$2279**

A very hot Takahashi's is the unique **FCL-90 *Sky 90*** 90mm f/5.6 refractor. With its self-storing dew shield retracted, as shown above, this remarkable telescope is less than 14" long! It makes a great traveller scope that you can stow away anywhere – *and it's available!*

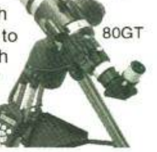
We also stock the 22" long Takahashi **FSQ-106N** 4" 4-element f/5 dual fluorite astrograph apo refractor OTA. It's also a great travelling scope.

If you want premium optics, and you want them *now*, the first name you should think of is Takahashi. The second name should be . . . ***astronomics***.

Go-to computerized scopes you assemble in minutes!

CELESTRON

~~$858 list~~
$499
114GT


~~$658 list~~
$399
80GT

You won't spend hours assembling these **Celestron NexStar** go-to scopes. They're preassembled, so all you do is slip the scope base into the tripod, hand tighten one large knob, and you're ready to observe . . . with no tools needed! You get two eyepieces, a Star Pointer finder, dual motor drives, an adjustable height tripod with accessory tray, and a 4000+ object go-to computer. The **Celestron NexStar 114GT** to the left is a 4.5" aperture 1000mm focal length f/9 reflector. The **Celestron NexStar 80GT** to the right is a 3.1" aperture 400mm focal length f/5 refractor. Both are so sensationally easy to assemble and use that you'll be observing a mere 10 minutes after you get one.

A 4" computerized go-to Mak for $699!

~~$1238 list~~
$699
NS4

The 4000+ object computer of the new **Celestron NexStar 4** Maksutov-Cassegrain is standard equipment, not an option as it is with some scopes. The computer hand control docks conveniently in the scope's sleek single fork arm mount. The battery-operated tabletop mount NexStar 4 is so easy to use that you'll be observing a short 10 minutes after you get one, even if you've never owned a telescope before.

One small step for man.
One quantum leap for binocular observing!

"Truly a quantum leap in binocular observing," is what *Sky & Telescope* said about the Canon image-stabilized binoculars. They also said "astounding . . . supercrisp . . . particularly impressive was how well these binoculars compared to much larger apertures . . ." There's no shake, no blur, no jittery images during hand-held, rock-solid, astronomical observing. The newest image-stabilized Canon binoculars are the 15 x 50mm, shown to the right, and a higher power 18 x 50mm. A useful option with both binoculars is a pair of specially coated fog-proof eyepieces that help keep the images sharp and moisture-free all night long.

$1499

Canon

24-Hour FAX line: (405) 447-3337 Our e-mail address: questions@astronomics.com

Our multiple award-winning Internet address: www.astronomics.com

Our phone lines are open 10 to 7 CST, Monday thru Friday, and most Saturdays from 12 to 5.

Mastercard, Visa, Discover, American Express. U. S. sales *only*.

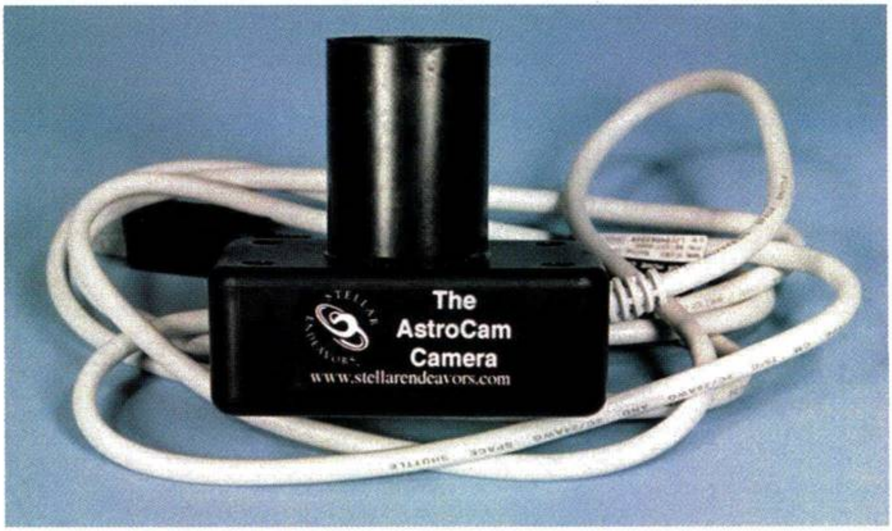
No credit card surcharge. $6.95 minimum freight. All returns less freight. Restocking fees apply to returns for credit and to merchandise returned used or damaged.

A PRODUCTS

AstroCam

▶ One of the most inexpensive digital cameras designed for use with a telescope is the AstroCam. The heart of the camera is a 340-by-280 pixel CCD chip, which is designed to capture images of bright objects such as the filtered sun, moon, and planets. The product is intended for beginners.

The AstroCam includes a USB port to connect to a computer and software that allows users to take stills or make movies and adjust for gain, contrast, and image brightness. "It's easy," says Benjamin Senson, chief executive officer of Stellar Endeavors Inc., the company that makes and sells the camera. "You can be up and running in less than 30 minutes."



Stellar Endeavors, Inc., 1102 Temkin Ave., Madison, WI 53705; phone, (608) 238-7511; fax, (608) 218-9303; e-mail, customerservice@stellarendeavors.com; website, http://www.stellarendeavors.com. $196 (plus shipping).

Sky/View 360 Astro Observatory

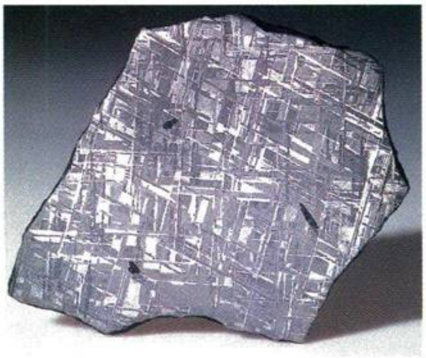
▶ A Maryland company is selling a 10-foot tall, 10-foot diameter observatory weighing 1,000 pounds. It has steel walls, a fiberglass dome, and a pressure-treated wood floor. No concrete pad is needed, and the round shed without the dome passed a 120-mile-per-hour wind test, according to the owners of Virgo Astronomics, the firm that developed and sells the observatory.

Set-up requires four adults familiar with ordinary hand tools. Written instructions and a video are included. The building is secure, simple to operate, and comes with a 10-year warranty.

Virgo Astronomics, 608 Falconbridge Dr., Suite 46, Joppa, MD 21085; phone, (410) 679-7055; fax, (410) 679-2376; e-mail, virgoastronomics@erols.com; website, http://Astronomy-mall.com. $6,500 (plus shipping and handling).

Gibeon Meteorite

▶ If you haven't found a meteorite, here's your chance to buy one and put it on a shelf or wear it around your neck. Meteorites are sold whole, crafted into rings and necklace pendants, sliced like bread, or fashioned into implements such as knife blades.



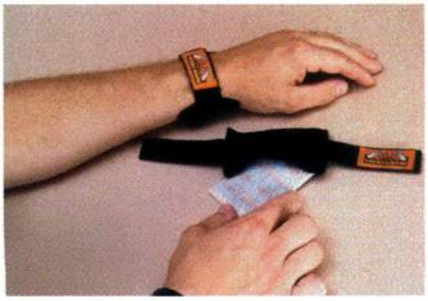
The Gibeon Meteorite is an iron meteorite that was ignored for years by residents of Gibeon, Namibia, before its significance was discovered in 1836.

Bethany Sciences, LLC, P.O. Box 3726-A, Amity Station, New Haven, CT 06525-0726; phone, (203) 393-3395; fax, (203) 393-2457; e-mail, bethanysci@aol.com; website, http://www.universecollection.com. $2 per gram (plus shipping and handling; $2 for a 32-page catalog).

Crazy ThermaBand

▶ Are your chronically cold hands hurting your ability to focus your telescope? If your gloves fail to keep your hands warm, maybe the Crazy ThermaBand, which is available at retailers and can be ordered from the manufacturer, can help. It has a fleece pocket that comfortably holds a disposable Crazy HotPad against the wearer's wrist.

The pad is made from nontoxic materials and maintains a temperature of 135° F for eight hours. An adjustable wristband also is available that makes it suitable for various sizes.



Crazy Creek Products, 1401 S. Broadway, Red Lodge, MT 59068; phone, (800) 331-0304; fax, (406) 446-1411; e-mail, thermaband@crazycreek.com; website, http://www.crazycreek.com. $6.99 (includes two bands and two disposable hot pads).

the LARGEST Astronomy & Telescope show in the US!

10th Annual

NORTHEAST ASTRONOMY FORUM & TELESCOPE SHOW

MAY 5 & 6

ROCKLAND COMMUNITY COLLEGE
145 COLLEGE ROAD, SUFFERN, NEW YORK

HIGHLIGHTS

May 5: Noon - 6pm
May 6: 8:30am - 5:30pm

- Over 70 vendors
- Programs for children
- Starlab planetarium shows
- On-site food service
- CCD Imaging workshops conducted by Richard Berry
- Free swap tables - call for info
- Free booths for clubs - call for info

SIX LECTURES (MAY 6) ON VARIOUS TOPICS

9:00am-10:00am	David Eicher, Astronomy Magazine
10:20am-11:20am	Tim Puckett "POSS Puckett Observatory Supernova Search"
11:40am-12:40pm	Bob Berman "Mysteries for the New Millennium"
1:40pm-2:40pm	Gary Seronik, Sky & Telescope Magazine
3:00pm-4:00pm	Dr. H. John Wood, NASA
4:30pm-5:30pm	Dr. Alex Fillipenko, UC-Berkeley

FOR ADDITIONAL INFORMATION:

973-427-2020

www.rocklandastronomy.com

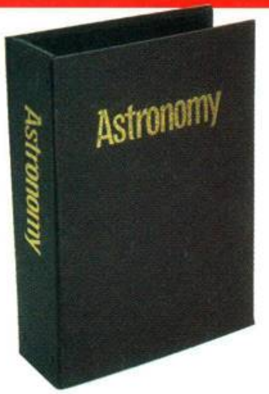
Or write to: Alan Traino, 447 Manchester Ave, North Haledon, NJ 07508

Admission fees: $10.00 adults, $5.00 students 12-18,
Free for kids aged 11 and under (with parent).
Admission fees will be charged each day.

Astronomy Magazine
is proud to sponsor the
Northeast Astronomy Forum & Telescope Show.

Rockland Astronomy Club
New York

PROTECT YOUR INVESTMENT!



Preserve your library of *ASTRONOMY* Magazines with durable hardcover binders.

ITEM NO. 14007
1 for $12.95 • 3 for $35.95
5 for $54.95

Order yours today!

TO ORDER BY MAIL: Send your order to Kalmbach Publishing Co., Dept. AFIL, 21027 Crossroads Circle, P.O. Box 986, Waukesha, WI 53187-0986. Use chart below for shipping & handling charges.

MERCHANDISE TOTAL	ADD
$10.00 or less	$3.95
$10.01-$30.00	$4.95
$30.01-$50.00	$5.95
$50.01-$75.00	$6.95
$75.01 or more	$7.95

Canada add an additional $2.00, other foreign add an additional $5.00. For Wisconsin delivery, add 5% sales tax to total; for Pennsylvania delivery, add 6% sales tax to total. For delivery in Canada add 7% GST to total. Payable in U.S. funds. Checks must be drawn on a U.S. bank except for those from Canada; GST included. Make checks payable to Kalmbach Publishing Co. Prices and availability subject to change.

call 800-533-6644

Mon-Fri, 8:30am-5:00pm Central Time.
Outside the U.S. and Canada, call 262-796-8776.
Please have your credit card ready.

fax 262-796-1615

www kalmbachbooks.com

Secure online ordering available.

Astronomy

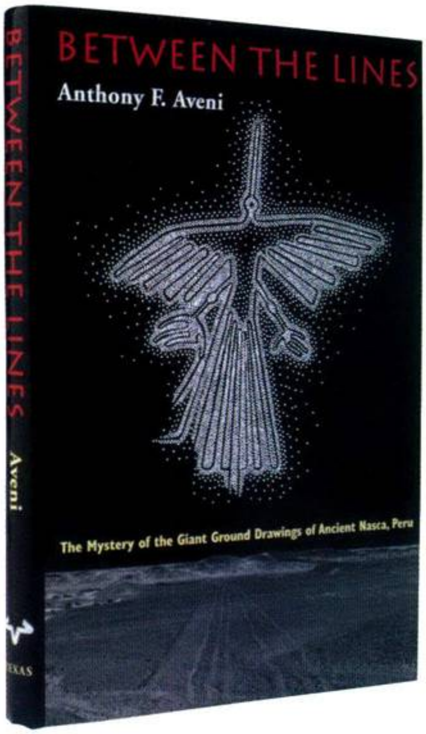
5664-0012 AFIL

BOOKS

Between the Lines: The Mystery of the Giant Ground Drawings of Ancient Nasca, Peru

Anthony F. Aveni, 257 pages, University of Texas Press, Austin, 2000; ISBN 0-292-70496-8; hardcover, $39.95.

▶ *"Thousands of years ago, in obedience to direct orders from the Initiators or for the purpose of perpetuating the teachings they had received in the past, they created the vast page of writing that is Nasca."* — French adventurer Robert Charroux.


BETWEEN THE LINES
Anthony F. Aveni
The Mystery of the Giant Ground Drawings of Ancient Nasca, Peru
BETWEEN THE LINES
Aveni
TEXAS

For some, it's more fun to entertain the idea of intelligent aliens dropping in to get us started than to credit the ingenuity of ancient civilizations. That's exactly what seems to happen to anyone who sees the approximately 1,500-year-old lines and curving figures on the barren Peruvian pampas. Could the enigmatic lines be starship runways? Racing or sports corridors? Irrigation lines? Pioneering archeoastronomer Aveni takes a common-sense look at these giant drawings, consults with experts, and sheds light on an ancient mystery in *Between the Lines.*

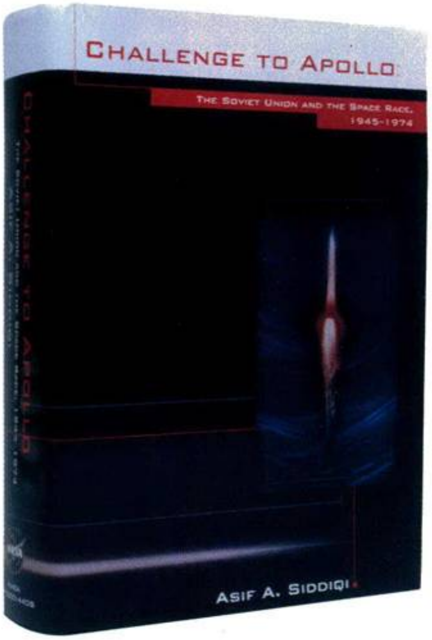
Although Aveni doesn't mention possible connections between the Nasca lines and stars until about one-third of the way into the book, readers won't mind the delay. Aveni needs that space to acquaint us with the sizes, shapes, and locations of the Nasca lines. He compares them to more famous wonders of the ancient world. Aveni also delves into the history behind the ancients who created the lost civilization in Peru. Along the way, he introduces characters and researchers who developed the many plausible (and outlandish) ideas purporting to explain the drawings.

Aveni then focuses on possible links between astronomy and specific sites on the pampas. With students or Earthwatch volunteers in tow, Aveni studies the connection between celestial events and engineering feats on the ground. Students even construct their own line drawings, using tools and measuring devices similar to those that would have been available a millennium ago, to determine time and difficulty involved in reproducing the work of the Nasca. Aveni's compelling results will surprise readers expecting complicated answers.

While not strictly a book for skywatchers, *Between the Lines* will appeal to anyone interested in ancient traditions and cultures, and how indelible links may have formed between astronomy and everyday life. Because the Nasca left only vague archaeological records, no one will ever really know their secrets. But Aveni's explanation — which never divorces the cultural needs of the designers from their Brobdingnagian works — may come closest to reality. — *Carol Ryback, associate editor*

Challenge to Apollo: The Soviet Union and the Space Race, 1945–1974

Asif A. Siddiqi; 1,011 pages, NASA History Div., Office of Policy and Plans, Washington, D.C., 2000; NASA-SP-2000-4408, hardcover, $79 (U.S.), $98.75 (non-U.S.). Stock number 033-000-01231-4. To order, write: Superintendent of Documents, P.O. Box 371954, Pittsburgh, PA 15250-7954; phone, (202) 512-1800; fax, (202) 512-2250; website, http://bookstore.gpo.gov/index.html.



▶ From 1969 to 1972, American astronauts aboard six Apollo missions explored the moon, providing a "Rosetta stone" for understanding the solar system. From the point of view of many Americans in the 1960s, however, the moon race was not about gaining knowledge — it was about beating the Russians. Putting Apollo's victory in context requires an understanding of the Soviet moon program. Documents released after the fall of Soviet Communism gave NASA something to talk about.

Challenge to Apollo is the first large-scale account of the Soviet Union's performance in the 1960s moon race published by the NASA History Office. Author Siddiqi, a doctoral candidate in history at Carnegie Mellon University in Pittsburgh, Pennsylvania, has produced a massive brick of a book. He packed it with more than 1,000 pages of dramatic events, hardware details, and personality profiles.

Siddiqi explores how the Kremlin leadership enjoyed space victories that were direct outgrowths of their military programs, but remained reluctant to allocate rubles to fund development of the nonmilitary hardware required for lunar flight. He explains why Kremlin leaders didn't fully commit to racing Apollo until 1967 — six years after President John F. Kennedy's

Computerized Telescopes!

Meade Computer-controlled telescopes automatically find 1000's of objects with the push of a single button!

NEW!

ETX 70/AT
$\$349^{95}$

Portable!

Optional Autostar Shown

5" Aperture!

Optional Autostar Shown

NEW!

Priced $500 Less than last year!

ETX 60/AT
$\$299^{95}$

Special section on our web site for ETX accy's!

ETX 90/EC
~~$\$599^{95}$~~ ON SALE CALL!

ETX 125/EC
~~$\$899^{95}$~~ ON SALE CALL!

8" LX90
$\$1699^{00}$

7"-12" LX200's
$Call

Accessories for your Computer-Controlled Telescope!

	60/70AT	90/EC	125/EC	LX90	LX200	Next5	Next8	
Autostar GOTO #497		x	x			x		$150
Ac adapter #541	x	x	x	x				42
Barlow 2x APO Shorty	x	x	x	x	x	x	x	80
Case- hard #773	x							60
Case- hard attache		x						100
Case- hard #775			x					150
Case- hard w/wheels		x	x	x		x	x	249
Case- soft Deluxe		x						80
Case- soft					x	x		call
Car cord 12 volt #607		x	x	x				30
Car cord 12 volt						x	x	25
Car cord 12 volt #1812					x			90
Camera adapter #64		x	x					37
Camera adapter #64ST	x							27
Camera adapter SCT				x	x	x	x	32
Dew Shield	x							21
Electric focuser #1244		x						124
Electric focuser #1247			x					124
We've got 2500 items in our New Catalog... Call or request one at www.shutan.com								
Finderscope R/A #825		x						52
Finderscope R/A #827	x							52
Moon filter 1.25"	x	x	x	x	x	x	x	18
Power Set 3Ah	x	x	x					100
Power Set 7Ah				x				110
Power Set 7Ah						x	x	95
Prism 45° erect #932		x	x					50
Prism 45° erect #933	x							50
Rigel Quickfinder	x	x	x	x	x	x	x	40
Skychart 505 Software	x	x	x	x				55
Skychart 506 Software	x							50
Solar Filter- glass (60/70)	x							68
Solar Filter- glass (90mm)		x						82
Solar Filter- glass (5")			x			x		104
Solar Filter- glass (8")				x	x		x	139
Solar Filter- glass (10")					x			159
SCT thread adapter	x	x	x					32
Tripod- tabletop #880	x	x						32
Tripod- tabletop #881			x					62
Tripod- deluxe field #882	x							100
Tripod- deluxe field #883	x	x	x					200
Tripod- deluxe field #887		x	x					350

New NexStars!

NEW!

Newest in the Nexstar family. All come with motors and electronics pre-assembled.

- 60mm Refractor
- 80mm Refractor
- 4" Maksutov
- 4.5" Newtonian

www.shutan.com for details!

Celestron

NexStar-5

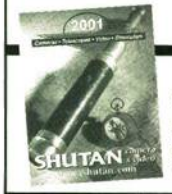
~~$\$1199^{00}$~~

Call for Promo Pricing and Tripod Options!

NexStar-8

~~$\$1699^{00}$~~

Powered by just 8-AA batteries, the NexStar can slew to any one of over 18,000 objects in its onboard database! Sturdy and solid. All load bearing components like the fork arm and drive base are made of metal for rigid low vibration performance. Two servo motors provide long operational life and quiet and accurate pointing. ***We carry tons of NexStar accessories such as RS232 cables, Car Cords, Rechargeable Battery Packs, Accessory Trays, Piggyback Brackets, Hard Cases, Soft Cases, Rolling Cases, Solar Filters, Barlows, Skylight Filters, Vibration Pads, Camera Adapters, and more!***



Order these and hundreds of other items online at www.shutan.com

Order Toll-Free or Online! Call us or visit our web site for **New 2001 Discount Catalog!** Order by **NOON** for same-day shipment. C.O.D. available, please inquire. We ship most accessory orders up to 5 lbs. for just **$7** via UPS Ground. **Non-Meade** products are available for **Worldwide** shipment-- information at www.shutan.com. Shutan is family **owned** and **operated** since 1918! Prices, specifications, and trade-in offers subject to change and do not include shipping/handling. **© 12/2000 SC&V.**

SHUTAN
camera & video

We welcome bids & PO's from Schools!

Toll-Free 800-621-2248
Illinois 847-367-4600 • www.shutan.com
100 Fairway Dr. • Vernon Hills IL • 60061

We Moved!

"moon speech." NASA challenged the chaotic Soviet space program, which had no single leader. Instead, the rival bosses competed for scarce resources, to the detriment of the Soviet space effort as a whole. For example, Siddiqi traces technical problems leading to the failure of the Soviet N1 moon rocket to a bitter falling out between two design chiefs.

Siddiqi's book begs a hard question: If the Soviet Union really was such a poor competitor, what did NASA's victory mean? From the perspective of more than 30 years the answer is, of course, already plain. Though born of struggle for ephemeral geopolitical advantage, Apollo's victory yielded an enduring prize of knowledge.

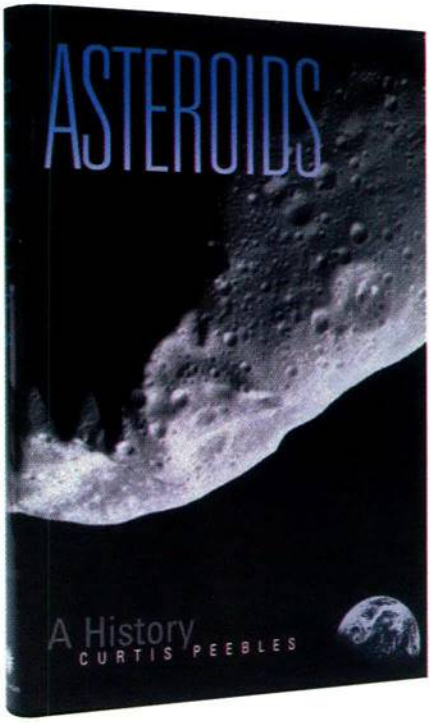
Challenge to Apollo will appeal most to readers who want to learn about the situations and personalities involved in the U.S./Soviet moon race. — *David S. F. Portree (NASA will publish his book,* Humans to Mars: Fifty Years of Mission Planning, *in 2001.)*

Asteroids: A History

Curtis Peebles, 280 pages, Smithsonian Institution Press, Washington, D.C., 2000; ISBN 1-56098-389-2; hardcover, $29.95.

For its size, *Asteroids: A History* includes an astonishing number of facts about the discovery, naming, and fate of the stepchildren of the solar system. Professional and amateur astronomers have found roughly 128,000 "minor planets," and the total, which includes more than 18,000 numbered asteroids with defined orbits, continues to climb.

Peebles provides an informative discussion of the pivotal role played by technology in the discovery of smaller and smaller members of this chaotic family. For example, prior to digital imagery and robotic telescopes, asteroid hunters used photography and blink-microscope comparators. The comparator, which was made obsolete by computer software, allowed a patient observer with steady eyes to look at thousands of pairs of images for the occasional asteroid or comet that appeared to jump back and forth across a stationary field of stars. The first asteroid discoverers had even less to work with. It's hard to imagine the incredible effort required by these 19th-century observers who simply looked through telescopes for faint points of light that moved relative to background stars, observations needed to claim a discovery.



Peebles's writing style is rapid-fire, yet deliberate. He organizes the first three chapters around what he calls the three historical phases of asteroid research, beginning with the discovery 200 years ago of 1 Ceres (the number 1 indicates that Ceres was the first asteroid to have its orbit calculated). The third chapter concludes with the discovery in 1996 of a large crater on 4 Vesta. Of course, the modern era takes up most of the remainder of the book, making the chronological beginning seem artificial.

Peebles's detached tone remains remarkably uniform, whether he describes various members of the Main Asteroid Belt between Mars and Jupiter or the dangerous near-Earth interlopers. I found the author's lack of emotional modulation as he switched from the interesting to the dangerous to be disorienting.

I also expected *Asteroids* to be written with the clarity, graceful style, and compelling storytelling techniques so effectively employed by Gerrit L. Verschuur in his 1996 book *Impact: The Threat of Comets and Asteroids.* Unfortunately, Peebles doesn't exhibit Verschuur's storytelling flair. For example, Christian Heinrich Friedrich Peters, a great 19th-century asteroid hunter who once chose a cigar over a meal, died with a burned-out stogie between his fingers. While Peebles notes Peters's final cigar, he doesn't set it up for dramatic effect; it becomes a useless footnote instead of a meaningful anecdote.

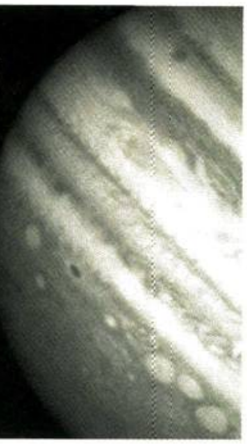
With thousands of asteroids to consider, Peebles picks a nice selection that satisfies the readers' interest in individual objects — but leaves the majority of the asteroids out of focus. He also should more clearly spell out the differences between asteroids (objects whose telescopic appearances are stellar) and comets (objects that display evidence of comae or tails). Most planetary scientists also categorize asteroids and comets in terms of their genealogy, with asteroids arising in the relatively warm Main Asteroid Belt and comets originating in the frigid outer solar system. Some comets even end up as asteroids when they shed all their volatile gases. Too bad Peebles didn't pay more attention to these historically relevant discussions.

Peebles handles a small number of controversies cleanly, accurately, and matter-of-factly. The less dutiful Verschuur mines the same academic conflicts about craters, the Asteroid Belt, and the outer solar system, not only for what they say about asteroids, but also for what they reveal about how science takes place.

Minor-planet aficionados should not hesitate to add *Asteroids: A History* to their libraries, but they should also keep in mind what science historian W. S. Anglin once wrote about mathematics: "It is not a careful march down a well-cleared highway, but a journey into a strange wilderness." Anglin could also have been describing astronomy. Readers who enjoy Peebles's book should leave room on their shelves for future popular books about — as Peebles describes them — "irregular splinters of collisions ages ago." — *Rex Graham, senior editor*

F. C. Meichsner Co., Inc.

Our 81 years of experience and knowledge will help you get the best optics for your money!



☆ Celestron ☆ Miyauchi ☆ Used Equipment
☆ Meade ☆ Fujinon ☆ Repair Service
☆ Tele Vue ☆ Nikon ☆ Large Showroom
☆ Takahashi ☆ Swift ☆ Worldwide Shipping
☆ Questar ☆ Bushnell ☆ Free Price List

☆ Accessories Always in Stock • Call for Monthy Specials

Call us at: **(800) 321-VIEW!** (8439)
Fax: 617-426-0837 (24 hours)
E-Mail: Meichs@aol.com
Visit us at: **182 Lincoln Street, Boston, MA 02111**
Web site: http://www.meichsner.com

the right stuff

at the right place

for the right price

NEW Celestron NexStar 8!

NexStar Plossls

Books
Sky Charts
Software
Astronomical
Binoculars

Dew Shields

NexStar Cases

Complete GOTO Telescope with 18,000+ object database. Includes 81X Plossl eyepiece, AC Adapter, Star Diagonal, Star Pointer finder and Adjustable Aluminum Tripod.
All for only $1699.00!

Telescopes * Binoculars * Eyepieces * Filters * Tripods/Mounts
Dec/Focus Motors * Sky Maps/Books * Star Pointers/Finders
Complete Selection of Telescope Accessories

EAGLE OPTICS
(800) 289-1132
www.eagleoptics.com
2120 W. Greenview Dr. #4 Middleton, WI 53562

©

IDENTI-VIEW™

PREMIUM GLASS SOLAR FILTERS

- SAFE • HIGH QUALITY
- STRICT CONTROL STANDARDS
- LIMITED LIFETIME WARRANTY

CLASS "A"

Color band - blue. Class "A" filters are made with the same premium quality polished glass and multi-alloy coating as Class "B". An additional steel alloy added to the coating process makes our Class "A" filters extremely scratch and fade resistant. Excellent for visual and photographic use. Light transmission is 1/1000th of 1%.

CLASS "B"

Color band - white. Class "B" filters are made with polished glass and multi-alloy coating. These filters offer great durability and will provide many years of service and enjoyment with normal use. Can be used visually and for photography. Light transmission is 1/1000th of 1%.

CLASS "C"

Color band - red. Class "C" filters are specifically coated to a lighter density (ND-4). They are for photographic use only. This filter is intended for use by professionals and serious hobbyists. Light transmission is 1/100th of 1%.

ORDERING INFORMATION

1. State scope brand and model number, aperture and outside diameter with filter class and price.
2. Make check or money order payable to J.M.B. Inc. All foreign checks must be payable through a U.S. bank.
3. Shipped free within the continental United States. All others add $5.50 Shipping and Handling per filter. Michigan residents add 6% sales tax, allow 2-3 weeks for delivery.

VISA **J.M.B. INC.** MasterCard
736 Oak Glen Circle • Fall Branch, TN 37656
(423) 348-8883 • FAX (423) 348-6389
"Imitated but never duplicated"

Hardin
Optical

The Astronomy Company

Telescopes, Binoculars, Mounts, Eyepieces and Accessories for astronomers of all ages, from beginners to experts.

Celestron • Meade • Tele Vue
Astrola Mirrors • Bushnell
Brunton • Leupold • Nikon
Byers • Leica • Losmandy
Takahashi • JMI • Fujinon
and many other quality brands

call 1-877-447-4847 toll free
or visit our online store at
HardinOptical.com

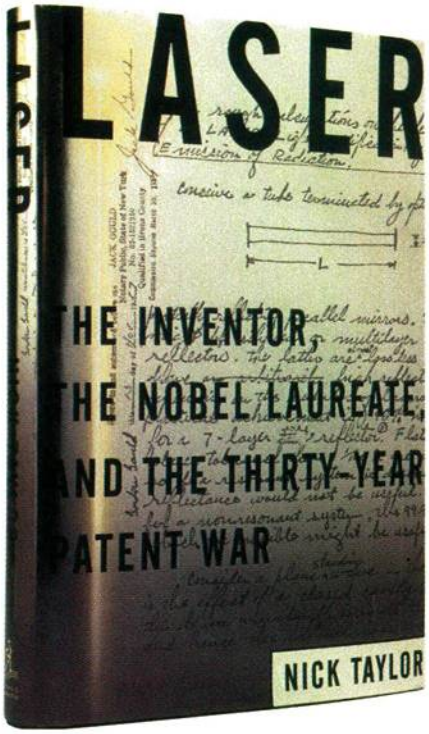
LASER: The Inventor, the Nobel Laureate, and the Thirty-Year Patent War

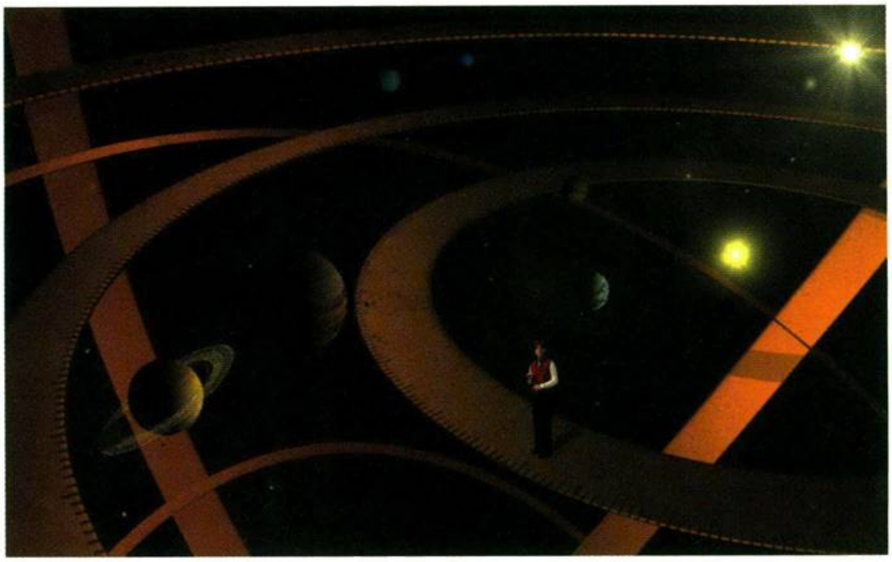
Nick Taylor, 304 pages, Simon & Schuster, New York, 2000; ISBN 0-684-83515-0; hardcover, $27.50.

▶ The idea of the laser — Light Amplification by Stimulated Emission of Radiation — came to physicist Gordon Gould in the middle of one night in November 1957. He jumped out of bed and began filling a notebook with his calculations for harnessing the power of light waves. Three days later, Gould had the equations notarized — a brilliant insight. Although his idea proved to be one of the most crucial technical advances of the 20th century, Gould's lack of an advanced degree and political connections prevented him from working on the project. *Laser: The Inventor, the Nobel Laureate, and the Thirty-Year Patent War*, by Nick Taylor, tells the story of how Gould fought to obtain several laser patents and eventually garner the respect of fellow scientists.

Taylor describes Gould's struggle in a style that at times seems like a soap opera as it delves into his romantic relationships. It also shows how frustrating it is for an inventor not to reap the rewards of his ideas. As the tale develops, the reader understands how much perseverance it takes to butt heads with big business, especially with such high financial stakes.

This biographical account provides an interesting sidelight to an invention that today continues to spawn innovative applications. Taylor's experience with memoirs — most notably, former astronaut John Glenn — shows throughout the book. However, *Laser* will probably appeal most to those interested in the private stories behind technology. — *C. R.*


LASER
THE INVENTOR, THE NOBEL LAUREATE, AND THE THIRTY-YEAR PATENT WAR
NICK TAYLOR



MEDIA

Final Frontier

▶ A virtual orrery is the set for the British Broadcasting Corporation's monthly "Final Frontier" series about astronomy and space exploration. The series started in October 2000 and concludes in September 2001. The 30-minute episodes offer a guide to the current night sky using the orrery and a planetarium.

The series also will feature topics ranging from UFOs and archaeoastronomy to the history of astronomy and the use of virtual reality to investigate black holes. Episodes will include appearances by guest celebrities such as Patrick Moore, Arthur C. Clarke, Russell Grant, and Tim Rice.

The orrery, an animated representation of our solar system, is a texture-mapped 3-D model of the nine planets, complete with shadows and reflections. The set will allow the show's presenters to move and interact in a virtual world. Constellation maps will show current star patterns. Viewers need not worry about clouds, and meteor showers and lunar eclipses will appear right on cue.

Circlevision Productions; website, http://www.Open2.NET

The Webweaver Picks

Spring Equinox
On March 20, you won't be able to stand an egg on end without a prop, but you can impress your friends with equinox trivia. http://daphne.palomar.edu/jthorngren/tutorial.htm

American Assoc. of Amateur Astronomers
From sunspots to movies of Comet LINEAR, this group's website shows why the hobby is so much fun. http://www.corvus.com/aaaa.htm

Telescopes in Education
Attention teachers. With your help, students in grades K–12 can remotely use a 24-inch telescope at the Mount Wilson Observatory. http://tie.jpl.nasa.gov/

Astronomical Images and Animations
Like most metasites, this one has a few dead links, but it also has everything from an atlas of Mars to the Messier objects. http://wwwhpcc.astro.washington.edu/scied/astro/astroimage.html

Africa Eclipse Expedition

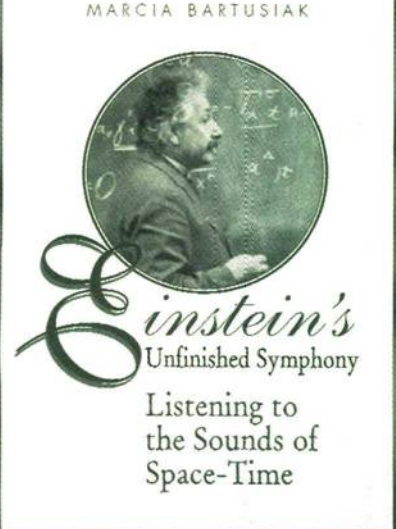
Join Eclipse Edge Expeditions June 14-22, 2001 as we explore Victoria Falls, Zimbabwe. Itinerary includes animal safari and best view of the total solar eclipse -- from near the path edge, where more and longer totality phenomena are seen.

Run by professional astronomers; our experienced team has selected sites to maximize weather prospects and will have mobility available if needed. Astronomy program includes southern sky observing. Optional activities include white water rafting, bungee jumping, elephant ride; and tethered balloon or helicopter view of the falls.

From $1750
short program originating
in Johannesburg

To $3900
full program, air from
Washington, DC

Eclipse Edge Expeditions 'Z01
P.O. Box 15186
Chevy Chase, MD 20825-5186
800-898-3343 (recording)
http://metaresearch.org/edge



MARCIA BARTUSIAK

Einstein's
Unfinished Symphony

Listening to
the Sounds of
Space-Time

In 1915, Einstein predicted the existence of gravity waves—this is the story of his "unfinished symphony," waiting nearly a century to be heard . . .

"Gives you a ringside seat at what is likely to be the next great revolution in astronomy."
—*Washington Post Book World*

"The reader of this book will feel like a participant in the great event."
—*The New York Times Book Review*

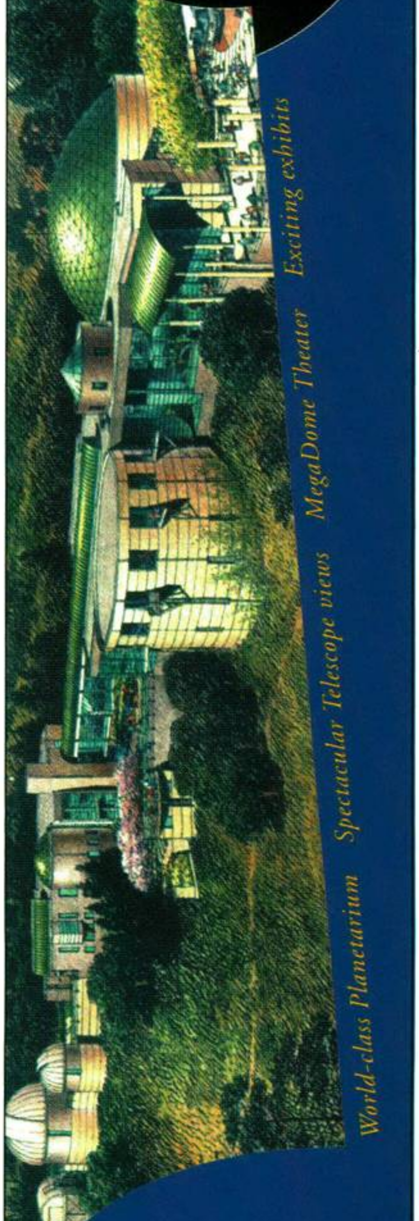
***New York Times* NOTABLE BOOK FOR 2000**
***U.S. News & World Report* TOP PICK**
Selection of Doubleday's Astronomy Book Club

JOSEPH HENRY PRESS
www.jhpress.org

Available at bookstores everywhere

chabot
space & science center

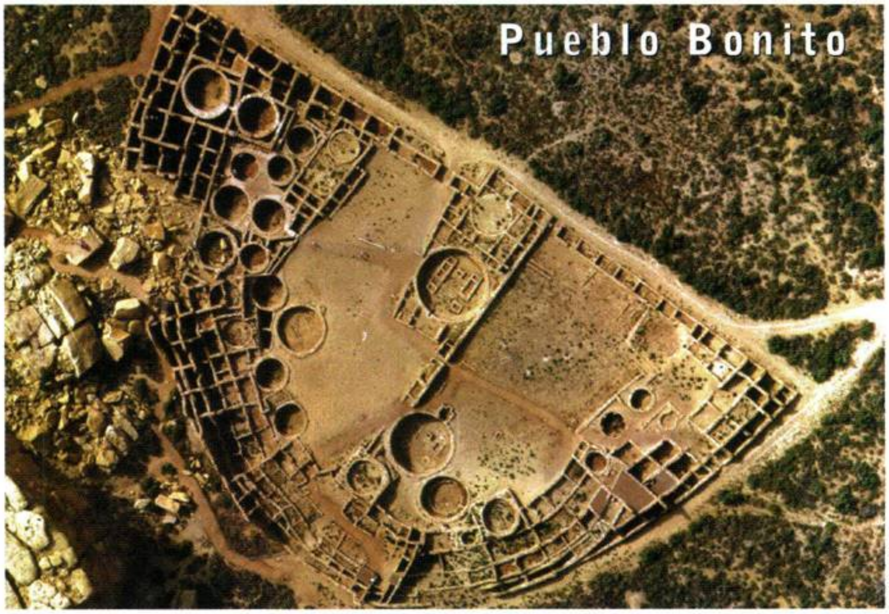
Majestically situated in the Oakland Hills



World-class Planetarium
Spectacular Telescope views
MegaDome Theater
Exciting exhibits

Advance Tickets:
510.601.TWEB
www.ticketweb.com

510.336.7300
www.chabotspace.org



Bullfrog Films

The Mystery of Chaco Canyon

▶ The stone ruins in Chaco Canyon, New Mexico, were an archaeological enigma until Anna Sofaer happened to be gazing at a spiral carving atop Fajada Butte one day in June 1977. A shaft of sunlight — a sun dagger — pierced the spiral's center about noon. Sofaer then founded The Solstice Project, an interdisciplinary group that has pieced together an astonishing picture of a culture that was extravagantly linked to ancient cosmology.

Water was scarce in the windswept, barren canyon. The dearth of household waste left behind suggests that few people actually lived there year-round. However, the ancient Chacoans built dozens of stone pueblos from A.D. 900 to 1130. The largest, most important building — Pueblo Bonito — was the size of the Roman Coliseum. Hundreds of circular ceremonial kivas could have accommodated 20,000 people, and thousands of clay pots were ceremonially broken there.

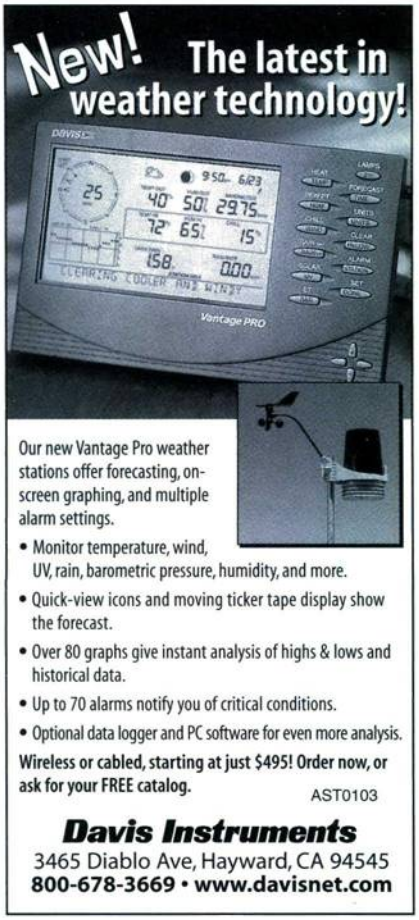
The Mystery of Chaco Canyon, a 56-minute video sequel to a previous Sofaer film, *The Sun Dagger*, and the 1997 book *Anasazi Architecture and American Design*, answers many of the questions surrounding the ancient culture. Sofaer also found equinox markers atop Fajada Butte and elsewhere in what is now called Chaco Culture National Historical Park. The video, narrated by Robert Redford, documents the Chacoans' understanding of solar and lunar cycles that they incorporated into a grand and complex architectural scheme. A wall at Pueblo Bonito is exactly aligned north-south and intersects an exterior wall that is aligned with the sun's rising and setting on the spring and fall equinoxes. Three other buildings have walls with the same solar orientation. Seven other buildings are aligned not only with the solar-aligned structures, but also with a little-known 18.6-year lunar cycle.

This film left me awed and eager to revisit a place with more meaning than I had ever imagined. — *Rex Graham, senior editor*

Bullfrog Films, P.O. Box 149, Oley, PA 19547; phone, (800) 543-3764, fax, (610) 370-1978; website, http://www.bullfrogfilms.com. $29.95 plus $5 shipping. **A**

PRODUCT INFO

Suppliers should send announcements and color photographs to Star Stuff, P.O. Box 1612, Waukesha, WI 53187, or e-mail starstuff@astronomy.com. *Astronomy* assumes no responsibility for the product information supplied by manufacturers. Prices are retail and subject to change without notice. Check *Astronomy*'s website for further product updates — http://www.astronomy.com


New! The latest in weather technology!

Our new Vantage Pro weather stations offer forecasting, on-screen graphing, and multiple alarm settings.

- Monitor temperature, wind, UV, rain, barometric pressure, humidity, and more.
- Quick-view icons and moving ticker tape display show the forecast.
- Over 80 graphs give instant analysis of highs & lows and historical data.
- Up to 70 alarms notify you of critical conditions.
- Optional data logger and PC software for even more analysis.

Wireless or cabled, starting at just $495! Order now, or ask for your FREE catalog. AST0103

Davis Instruments
3465 Diablo Ave, Hayward, CA 94545
800-678-3669 • www.davisnet.com

HOME-DOME® & PRO-DOME™

HD6S dome on a copper roof, in Czech Republic

- True Rotating Dome
- 6, 10, 15ft. Diameter
- Wide Slot Openings
- Easy Assembly
- All Fiberglass
- Complete Systems Priced from $2250

NEW - ROBO-DOME
Small Robotic Observatory
Unique and very affordable!

FREE Brochure

Technical Innovations, Inc.
22500 Old Hundred Rd.
Barnesville, MD 20838
Ph: 301-972-8040
Fax: 301-349-2441
www.homedome.com

www.camcor.com

Camera Corner

One of the largest Selections

- Telescopes • Spotting Scopes
- Binoculars • Tripods • Eye Pieces
- Accessories • Cases • Books
- Maps • Globes
- Cameras • Film
- Processing

All Name Brands Available

• Bushnell • Canon • Celestron • Fujinon • JMI • Kowa
• Leica • Meade • Nikon • Pentax • Tele Vue • SBIG • Steiner

Camera Corner
Established 1949
2273 South Church St. • Burlington, NC 27215
Voice 336-228-0251 • Fax 336-222-8011
e-mail: sky@camcor.com

800-868-2462

No gimmicks just service, selection... and great prices!

Knowledgeable staff to answer all your questions.

Telescopes our specialty

CELESTRON® showcase dealer

THE TELESCOPE STORE

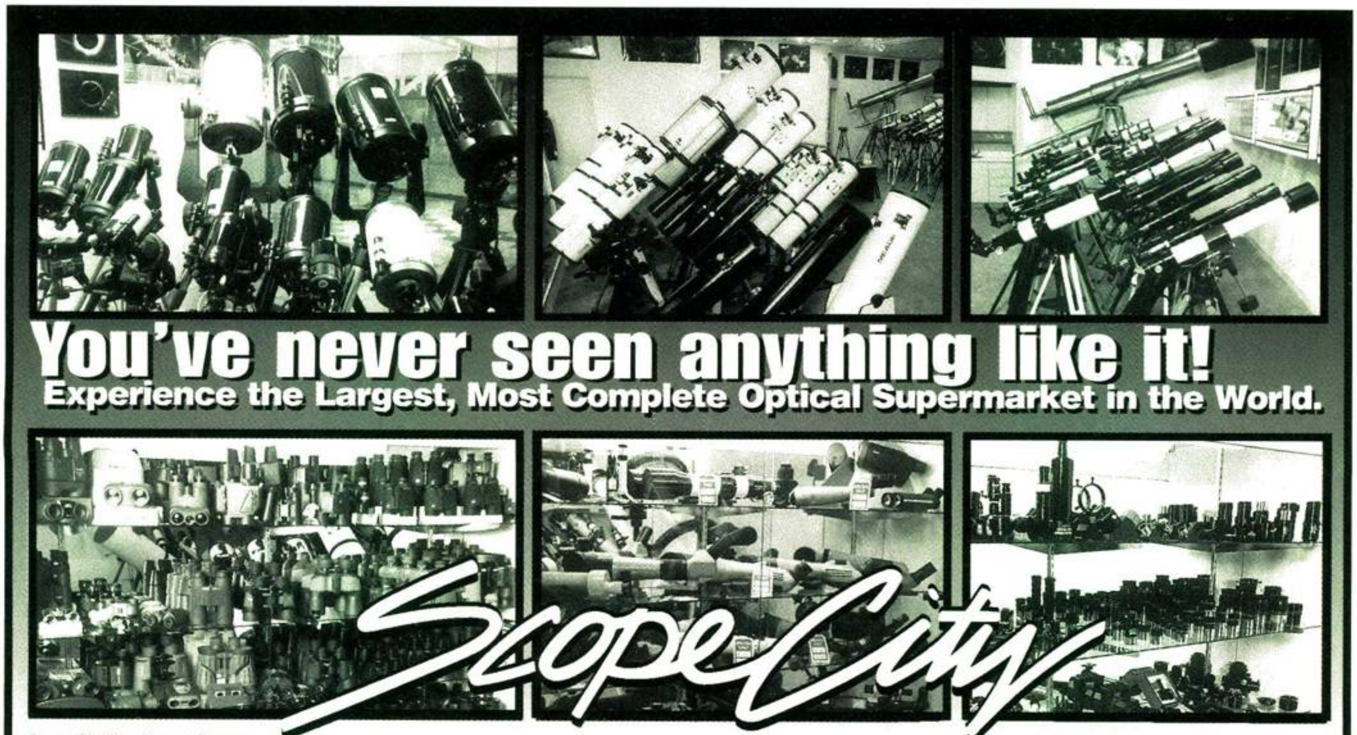
114 short
with tripod
$199

C150 HD
with tripod
$399

Nexstar 5
with tripod
$1,398

Nexstar 8
with tripod
$1699

www.telescopes-earth.com
(800) 550-7192


You've never seen anything like it!
Experience the Largest, Most Complete Optical Supermarket in the World.
Scope City

Scope City Locations / Showrooms
SIMI VALLEY, CA: 730 Easy Street, (805) 522-6646
SHERMAN OAKS, CA: 14324 Ventura Blvd., (818) 789-5805
COSTA MESA, CA: 3033 S. Bristol, (714) 957-6900
SAN DIEGO, CA: 4766 Clairemont Mesa Blvd., (858) 277-6686
LAS VEGAS, NV: 4825 W. Flamingo Rd., (702) 947-2673
SAN FRANCISCO, CA: 350 Bay Street, (415) 421-8800

Save up to 45%
All Major Brands
at discount prices

Buy
Sell
Trade
Service

MAIN OFFICE: 730 Easy Street,
Simi Valley, CA 93065, (805) 522-6646

Scope City / Mail Order
P.O. Box 440, Simi Valley, CA 93062
TEL: (805) 522-6670
www.scopecity.com

THIS IS WHAT HAPPENS WHEN YOU TELL YOUR ENGINEERS THE SKY'S THE LIMIT.

CELESTRON
GPS
GLOBAL POSITIONING SYSTEM
CELESTRON

They create the powerful, new NexStar® 11 GPS, which features technology never before found in a telescope. Practical technology like a Global Positioning System that will pinpoint your exact coordinates anywhere on earth. And the built-in digital compass, which quickly locates North for you, so your set up to star gaze becomes completely automatic.

Also new is our advanced Tour Function search engine with **over 40,000** objects in its database, including the complete RNGC, Messier, Caldwell, IC, Abell, selected SAO, planets, moon, and others. That's 10% more than any other telescope has, with future upgrades available on-line. Plus the computerized database can store the coordinates of numerous objects that you define.

Not only is the NexStar® 11 GPS quick to set up and easy to use, but the accuracy of this new technology is already winning rave reviews. In recent reviews the editors stated, ***"Our pointing tests with NexStar gave us perfect results every time."***

Perfect results every time. What more do you need to know?

©2000 Celestron International.

How about that NexStar® 11 GPS has **21% more light gathering power** than competitive 10" models. Or that the NexStar® 11 GPS is the first commercial telescope to incorporate a feature to prevent cord wrap, possible because all power comes through a non-moving drive base.

The NexStar® 11 GPS is also the only commercial telescope that has a **carbon fiber optical tube.** This aptly dubbed space-age material is lightweight, incredibly durable and has lower thermal expansion than aluminum and other metals. Making it perfect for the job at hand.

Each optical element in the NexStar® 11 GPS is individually hand figured and guaranteed to be diffraction-limited. Incredibly, Celestron is the only large commercial telescope builder to employ hand figuring – a complex optical procedure where ultra smooth corrections are made to the secondary mirror to ensure consistently high quality. Additionally, the primary and secondary mirrors have Starbright™ coatings applied for maximum reflectivity, with anti-reflection coatings on both sides of the corrector lens to provide maximum light transmission.

Combined, this long list of features makes the NexStar® 11 GPS the ultimate portable, large aperture telescope. Ideal not only for lunar, planetary and deep sky observing, but also for astrophotography and CCD imaging.

To own the NexStar® 11 GPS – the most advanced, quickest to set up, and easiest to use telescope we've ever designed – call your nearest Celestron dealer and reserve one of these marvels of engineering today.

NEXSTAR 11 GPS ACCESSORIES

MULTIPLE DATA PORTS FOR COMMUNICATION WITH PERSONAL COMPUTERS AND FUTURE SMART ACCESSORIES.

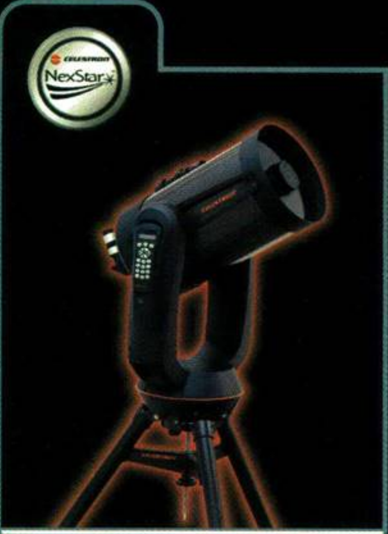
STANDARD:

- 40MM MULTI-COATED 1¼" PLÖSSL EYEPIECE (70X)
- 9X50 FINDERSCOPE
- AC ADAPTER
- CARBON FIBER TUBE
- 1¼" STAR DIAGONAL
- HEAVY DUTY TRIPOD

OPTIONAL:

- EQUATORIAL HEAVY DUTY WEDGE
- REDUCER/CORRECTOR F/6.3
- SOLAR FILTER
- CAR BATTERY ADAPTER
- EYEPIECE FILTERS
- PHOTO ADAPTERS
- 12-VOLT BATTERY SUPPLY

ALL THE RIGHT GEAR FOR THE FINAL FRONTIER



THE NEXSTAR 11 GPS ALSO COMES WITH THESE SMART FEATURES:

SOFTWARE:

- 40,000+ object database. Stores numerous user-defined objects.
- Upgradeable via the Internet

ELECTRONICS:

- Computerized hand control with easy-to-read backlit liquid crystal display (LCD) unit
- Permanent Periodic Error Correction (PPEC) – once periodic errors are recorded for elimination, the telescope maintains the recording even when turned off and on
- Built-in, adjustable backlash compensation
- Dual ports for RS-232 communication with a PC to operate and use with the telescope (one on hand control and one on base drive)
- Dual ports for serial communication with future smart accessories
- Solo port for AutoGuider
- Solo 12V DC power output for accessories

MECHANICAL

- Dual die-cast aluminum fork tines
- Large 9.5" roller bearing track for an ultra-stable polar axis
- 5.625", 180-tooth gears in both axes with precision worms (for accurate tracking)
- Hand control rests in its built-in home within the fork tine for easy usage

DAMPING TIME

- Less than one second

OPTICS

- 11" (279mm) large aperture Schmidt-Cassegrain optical system
- Focal length of 2800mm at f/10

WEIGHT

- Telescope weighs only 65 pounds
- Tripod weighs only 26 pounds

Call a Celestron dealer now to reserve your NexStar 11 GPS telescope at a special preview price.

FIND OUT MORE ABOUT NEXSTAR, OUR OTHER EXCEPTIONAL TELESCOPES, AND NEARBY DEALERS.
(310) 328-9560 • www.celestron.com

CELESTRON®

Astronomy's

Marketplace

Welcome to the MARKETPLACE section in ASTRONOMY Magazine. These pages are specifically designed to be an affordable and highly effective way for you to market astronomy-related products or services. Call Michael Ellis at 888-558-1544, ext. 636 to place your advertising message here.

krollkraft Sales & Service

A Divison of Wm. H.O. Kroll & Associates, Inc.

Binoculars, Scopes, Telescopes, Tripods, Mounts, and Accessories.
Domestic, German, Oriental and Russian.

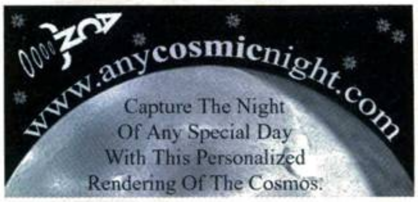
Box One, Excelsior, MN 55331
Phone 612-934-9494 FAX 612-934-1300

8" f/6 • 10" f/5
12.5" f/5
14.5" f/4.3
SEE
It Spin
Online!

Think Outside Of The Box

Mag 1 Instruments Portaball
Quick Set-up • Rotatable Tube
Optics by Zambuto Optics

mag1instruments.com
262-785-0926



Capture The Night
Of Any Special Day
With This Personalized
Rendering Of The Cosmos.

Weather Warehouse

Wired • Wireless • Solar

Weather Instruments

At Wholesale Prices

www.weatherwarehouse.com

Africa Solar Eclipse

Zambia, Zimbabwe

June 13-25, 2001
• Limited to 26 Participants •

- Best viewing site on the eclipse path
- Game drives in Zambia and Zimbabwe
- See Victoria Falls
- The smallest eclipse group around

Outer Edge Expeditions
800-322-5235 • 517-552-5300
adventure@outer-edge.com

NEW AUTHORS

PUBLISH YOUR WORK
ALL SUBJECTS CONSIDERED
WRITE, OR SEND YOUR MANUSCRIPT TO:
MINERVA PUBLISHING CO.
1001 BRICKELL BAY DR., # 2310, MIAMI, FL 33131

T&T BINOCULAR MOUNTS & BEYOND LLC

WHY PAY MORE?

We've got the goods for the best price.

CALL US!

18 Strong St. Extension
East Haven, CT 06512
(203) 469-2845 or (203) 272-1915
E-mail: TELloyd@aol.com

www.benjaminsweb.com/TandT

SCOPETRONIX

QUALITY ASTRONOMY PRODUCTS

PHONE/FAX
(941)945-6763

ORIGINAL EQUIPMENT AND AFTERMARKET
ACCESSORIES FOR ETX / NEXSTAR / LX SCOPES

LX50 "Dec Fix Kit" Improves Performance

Low Cost-High Quality Plossl Eyepieces

Joystick for LX200/Magellan II

ETX & NexStar Astro 300 Tripods

Celestar 8 & LX10 Astro 600 Tripod

Universal Digital Camera Adapter

ETX & NexStar Piggyback Mounts

WE ACCEPT:
DISCOVER
VISA
MasterCard
AMERICAN EXPRESS Cards

Flexi-Focus™ for the ETX

ETX & NexStar Eyepiece Racks

The "Dew Clip" Dew Heaters

The "Light Sight" Red Dot Finder

ETX & NexStar Photo Tripod Adapters

LX10/50 Deluxe Latitude Adjusters

Tripod Leg Clamps Fits ETX & Others

ScopeTronix, Inc.
1423 SE 10th Street
Unit 1A
Cape Coral, FL 33990
(941) 945-6763

Visit our new Showroom!

MEADE
CELESTRON
TeleVue Visionary

WE STOCK MEADE, CELESTRON, TELEVUE, ASTELE/LOMO, JMB, RIGEL, STARBOUND, CKC, & MUCH MORE!

24 HOUR ONLINE SHOPPING & SECURE ORDERING
WWW.SCOPETRONIX.COM

ASTRO-PHYSICS

High-quality instruments for discriminating observers and astrophotographers

Refractors- 105,130,155 mm dia.
Go-To German Equatorials
Visual and Photographic
Accessories

155 Starfire EDFS with 2.7" Focuser,
900GTO German Equatorial
Accessories

11250 Forest Hills Rd.
Rockford, IL 61115 USA
Ph: 815-282-1513, Fax: 815-282-9847
www.astro-physics.com

new mexico skies
GUEST OBSERVATORY

✰ *Spectacular Skies*
DARK Steady Mag 7+ skies
Great Seeing - 7300' elevation
Near: Apache Point & Sunspot

✰ *Great Equipment*
16"/12" Meade LX 200
14" Celestron / Paramount
7" Astro Physics APO
30"/25"/15" BIG Dobs
Full line SBIG CCD cameras

✰ *Modern Accommodations*
Full size kitchens/3-2-1 bedrooms

Mike and Lynn Rice, Astronomers
www.nmskies.com
info@nmskies.com
Phone: 505-687-2429/Fax: 505-687-3710
P. O. Box 559, Cloudcroft NM 88317

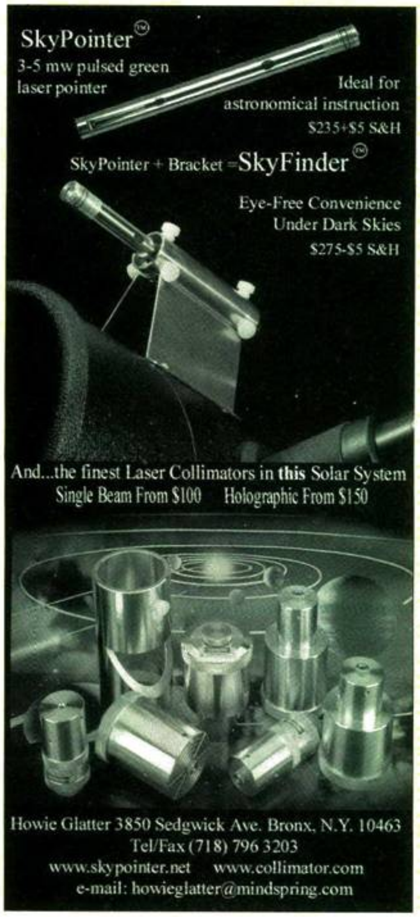
Bargain Books
Edward R. Hamilton, *Bookseller*
Shop America's *biggest* catalog selection, save up to 80%. **Astronomy**, Science, Computers, Photography, much more. Hundreds of new arrivals monthly.
Free Catalog: 1-800-677-3483
www.erhbooks.com/bmv

METEORITES!
Irons. Stones. Stony-irons. Tekites.
Quality display and study specimens.
Space jewelry, books, slides,
Authenticity guaranteed.
Color Catalog $2.
Bethany Sciences
P.O. Box 3726-A
New Haven, CT 06525
CATCH A FALLING STAR!
(203)393-3395

TELESCOPE KITS, LENSES, ACHROMATS MIRRORS, MIRROR BLANKS, ALUMINUM COATINGS & ACCESSORIES
BUY DIRECT ★ DO IT YOURSELF
Stock & Custom mirrors and molded mirror blanks, diagonals, parts made from Pyrex, optical glasses, fused silica, quartz and other low expansion ceramic materials. Telescope accessories, do-it-yourself books.
Write, call, fax or e-mail for catalog
NEWPORT GLASS WORKS, LTD.
P.O. Box 127
Stanton, CA 90680
PH: (714) 484-8100
FAX: (714) 484-8181
E-mail: astronomy@newportglass.com
Web: http://www.newportglass.com

...KITES!
Windsocks, Flags and Spinners
Traditional, Stunt and Power Kites
Free 80 page Catalog, or shop online at:
www.intothewind.com
1408-A Pearl St., Boulder, CO 80302 • (800) 541-0314

STAR TEK
FINE ASTRONOMY PRODUCTS
See our '3-in-1' tray and other new products at
www.startekind.com
Toll Free: 888-416-9480
Pat. Pend.



SkyPointer™
3-5 mw pulsed green laser pointer
Ideal for astronomical instruction
$235+$5 S&H

SkyPointer + Bracket =SkyFinder™
Eye-Free Convenience
Under Dark Skies
$275-$5 S&H

And...the finest Laser Collimators in **this** Solar System
Single Beam From $100 Holographic From $150

Howie Glatter 3850 Sedgwick Ave. Bronx, N.Y. 10463
Tel/Fax (718) 796 3203
www.skypointer.net www.collimator.com
e-mail: howieglatter@mindspring.com

METEORITES
Own a piece of another world!
Free Catalogue and Mailings
New England Meteoritical Services
Box 440-A, Mendon MA 01756 USA
Tel 508-478-4020 Fax 508-478-5104
www.TouchAnotherWorld.com

ECLIPSE SHADES™
Safe Solar Viewers
Custom Imprinting Available!
ECLIPSE SHADES™
SAFE FOR DIRECT SOLAR VIEWING
Eclipse Shades™ provide the ultimate in protection from harmful Solar Radiation. Lenses made of Optical Grade, Neutral Density 5 Mylar, filter out 100% of Ultra-Violet, 100% of Infra-Red, and 99.999% of Visible Light.
Quality Paper Eyewear & Specialty Optics
Rainbow Symphony, Inc.
6860 Canby Ave. #120, Reseda, CA 91335
1-800-821-5122 FAX (818) 708-8470
E-Mail: eclipse@rainbowsymphony.com
www.rainbowsymphony.com/soleclipse.html

International Dark-Sky Association
Promoting efficient lighting to reduce glare, to conserve energy, and to preserve the beauty of our night skies
To learn about *light pollution, energy waste, light trespass,* and related issues, or to join, ($30 basic membership), call or write to the non-profit
International Dark-Sky Association,
3225 N. First Avenue
Tucson, AZ 85719-2103
(520) 293-3198
(520) 293-3192 (fax)
http://www.darksky.org

Astronomy's

Marketplace

EUROPE'S PREMIER WEBSITE
http://www.scsastro.co.uk
SCS ASTRO

Single? (just as soon not be?)

Expand your social universe (and maybe meet your true love) though: ***Science Connection***

800-667-5179
www.sciconnect.com

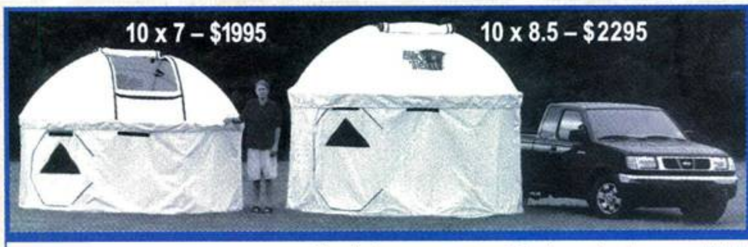
www.novaspace.com

ECLIPSE 2001
ADVENTURES

ALL NEW
AFRICA
MADAGASCAR

Call for **FREE** brochure: 800 830-1998

Journeys for Inquisitive Minds
TravelQuest
INTERNATIONAL
570 Skyview Dr., Prescott, Arizona 86303
Visit us: www.tq-international.com



It will change the way you look at the stars

Sky Tent®

- Simple 1-person setup–25 min, no tools
- Highly UV resistant
- Dome rotates 360° on stationary base
- Stable in 60mph+ wind
- Weighs 100 lbs, packs easily in car
- Blocks local light pollution
- Eliminates wind vibration & chill
- Withstands heavy rain & snow
- Several sizes, from $1995
- Portable or permanent installation

www.skytent.com TOLL FREE **1-877-SkyTent**

Star Hill Inn
an astronomy retreat in the rockies

Experience a unique dark sky vacation. Stay in charming private cottages on hundreds of acres of peaceful pines. 7200' elevation. Star tours, telescopes for rent, or use your own at our observatory. Astronomy, Birding and Art Workshops. Easy access to Santa Fe, Taos, Pecos Wilderness, Wildlife Refuges & Ski Resorts.
Open all year. For info:

Star Hill Inn
Sapello, New Mexico, 87745
505-425-5605
www.starhillinn.com

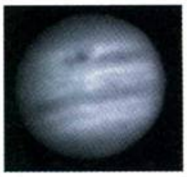
'SIRIUS' direct from **Australia**

Sizes
7'6" or 11'6" or 22'0" dia.

Solid Fibreglass, whisper quiet. Mechanised dome rotation and hatch openings available.
Visit www.siriusobservatories.com
e-mail info@siriusobservatories.com
Distributor or agent inquiries welcome.

Entry level CCD imaging
Includes camera, software and everything needed for prime focus & eyepiece projection in 24 bit color
407-259-6498

SAC
P.O. Box 360982
Melbourne, Fl. 32936
wsnyder@sac-imaging.com



SACIV
$224

www.sac-imaging.com

ASTROLA™ Mirrors
Build the telescope of your dreams.

Astrola 8-inch f/6 mirror set	*$ 950**
Astrola 10-inch f/6 mirror set	*$ 1195**
Astrola 12.5-inch f/6 mirror set	*$ 1495**

Hardin Optical Company
www.hardin-optical.com or call toll free: 1-877-447-4847
** F.O.B. Bandon, OR*

ROME TELESCOPE CORPORATION
Astronomy Products
Telescopes
Tripods
Binoculars
Accessories
(All Major Credit Cards Accepted)

www.rometelescope.com
Voice# 414-764-6890
Fax# 414-764-6895

Buy a Star ★ Name a Star

On the exclusive
MSAS Star Atlas
Soon to be placed in the newly-opened
MSAS Astronomy Village

Receive a certificate of
record and more.

Mtn. Skies Astronomical Society
Box 1169 - LkArwhd, CA. 92352

Free brochure.
Starting at
only $25.00!
VISA/MC accepted

(909) 336-1699
www.mountain-skies.org

ScopEquipment

Teleskopes - Mounts - Accessories

New !

High Quality
German Equatorial Mount
65 kg payload capacity
RA and DEC drive

only for
$4390

Langenbranderstr.42
D-76596 Forbach / Germany
www.scopequipment.de
FAX +49(0)7228 960316

PARFOCAL BRANDON® OCULARS

Effective focal lengths: 8, 12, 16, 24 and 32mm

STEP UP TO
BRANDON!

#1 for Contrast

VERNONSCOPE
& company

Division of
Gould Precision Optics Inc.

151 Court Street
Binghamton, NY 13901

Toll Free in US
888.303.3526

☎ 607.722.5697

607.722.7939

www.vernonscope.com

The truss line

ASM PRODUCTS

• Blanks • Mirrors • Accessories

$799.95 Truss telescope 8" to 14"

http: //pages.infinit.net/asmprod

Phone : 450.464.1410 Fax : 450.653-2870

REMOTE • RIVER • EXPEDITIONS

• The most unique eclipse itinerary being offered! •
• Total Solar Eclipse Madagascar 2001 •
• The Romance of Madagascar •
• Multi-activity tour • Small group •
• Lemurs, chameleons, baobabs, exciting birds,
bizarre spiny desert, beautiful forest •

Remote Rivers Expeditions
800-558-1083 • www.remoterivers.com

UNIVERSITY OPTICS, INC.
P.O. BOX 1205
ANN ARBOR, MICHIGAN 48106-1205

For over 37 years your source for everything astronomical including —

- Cookbook CCD Camera kits
- Eyepieces
- Telescope making parts

New Online Catalog
www.universityoptics.com

Call for FREE CATALOG
734-665-3575

Starsplitter Telescopes
Quality Focused on the Customer!

Starsplitter II
15"- 40"
Compacts
8"-15"

We offer the
largest
selection of
Newtonian
telescopes
on the
market today!

Please send $2.00
for a catalog.
Online catalog at
www.starsplitter.com

Starsplitter Tube
6"-10"
APO - Eater
6" f/10 & 8" f/8

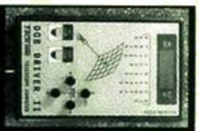
Starsplitter Telescopes
3228 Rikkard Drive
Thousand Oaks, CA 91362
805-492-0489 Phone & Fax
www.starsplitter.com

TOTAL ECLIPSE OF THE SUN - June 21, 2001

Be in Lusaka on the day to witness this very special event! From one day eclipse excursion charters ex Johannesburg to tailormade packages to include Zimbabwe and South Africa. Seats and accommodation are limited, so act now to avoid disappointment.

Further details from:
Liz Cotton, Sure Travel
Somerset West, South Africa
e-mail: janvz@travelsw.co.za
tel: ++27 21 851-6908 or fax: ++27 21 852-4655

THE
AMAZING
DOB DRIVER II



Dual axis microstep quartz drive fits all Dobsonians, or user-built equatorials. Powerful computerized tracking, panning, and guiding in the palm of your hand! Super portable, super simple, AC/DC/CAR/BAT 12V. Instant setup–NO ALIGNMENT! Multi-function display. Calibration supertunes your scope to maximum performance. Options for PC link/CCD link.

New Roboscope PC Software
Go to 13,000 + objects + any chart point

Control only - $349 ATM System - $510
Complete system w/ready-to-install drives - $599
Free catalog - satisfaction guaranteed!

TECH 2000
3349 SR99 S Monroeville, OH 44847
Ph. 419-465-2997 • Fax 419-465-2484
www.accnorwalk.com/~tddi/tech2000

ZAMBIA SOLAR ECLIPSE - 21 JUNE, 2001
EXPEDITION LEADER:
JOE MANACCI : LOUISVILLE ASTRONOMICAL SOCIETY
(30 year veteran eclipse chaser land and cruise ship)
NEW Solar Eclipse/Night Sky Expedition
(Lusaka, Vic. Falls & nightly Southern Sky observing)
US $ 1890.00 - 13 June - 23 June - ex Newark, NJ

For the serious astronomer...this very affordable expedition is designed if you wish to explore the southern skies at night. Your day-time activity can be as relaxed as you wish, allowing time to sleep and/or rest during the day to prepare for your nightly observing.

WE HAVE BEEN ARRANGING SOLAR ECLIPSES SINCE JUNE 1973
AFRICA IS OUR ONLY BUSINESS COMPARE US FOR VALUE!!!

Book now - very limited space
east african travel consultants inc.
574 Parliament Street
Toronto, ON. Canada M4X 1P8
Tel: 416-967-0067 Fax: 416-967-1613
www.africaonsafari.com
e-mail: eatc@idirect.com

OnSafari

2002 AFRICAN ECLIPSE EXPEDITIONS READY.

Astronomy®

Take another look at *Astronomy*!

Order back issues of
Astronomy today and rediscover
astronomical history!

http://books.kalmbach.com

For a complete listing of available back issues and featured stories,send a business-sized SASE to Kalmbach Publishing Co., ASY Back issues dept. 21027 Crossroads Circle, P.O. Box 1612, Waukesha, WI 53187-1612.

Astronomy's
Retail & Travel Directory

The Directory is designed to be a quick and easy way to locate astronomy-related retail stores, activities, planetariums and observatories. To advertise call toll free 1-888-558-1544 ext. 815

RETAIL SHOPS

ARIZONA - Phoenix 85032

THE ASTRONOMY SHOPPE

Telescopes (Meade, Celestron, Tele Vue®,
Orion, Takahashi) • Spotting Scopes • Binoculars
Eyepieces & Accessories • Maps • Books • Sky Tours
We welcome mail orders. Visa/MasterCard accepted.
astroshop@earthlink.net www.darkskyinc.com
3202 E. Greenway Rd. Suite 1615 (888) 999-6396

FLORIDA - Sarasota 34236

WOLF CAMERA

Telescopes
Meade
Celestron
Tele Vue®

CCD Equipment
Meade Pictor
Optec Max.
Accessories

WOLF CAMERA

The Largest Telescope Dealer in the Southeast!
New & used telescopes, CCD equipment & accessories, plus a huge selection of eyepieces and binoculars! Call Chuck Pisa our staff Astronomer with 20 years experience today!
www.wolfcamera.com Fax: (941) 952-0278
1055 S. Tamiami Trail (941) 957-4686

**When traveling, use the
Retail & Travel Directory
as your guide.**

GEORGIA - Atlanta 30306

CAMERA BUG

TELESCOPES • BINOCULARS • ACCESSORIES
EYEPIECES • SPOTTING SCOPES • MAPS • BOOKS

Canon • Celestron • Meade • Minolta • Olympus
Orion • Pentax • TeleVue® • Telrad • Rigel

WE SHIP ALMOST ANYWHERE!
www.camerabug.com
Fax: (404) 873-3925
Orders Only: (800) 545-8509
1799 Briarcliff Rd. (404) 873-4513

NEW YORK - Amityville 11701

BERGER BROS.
CAMERA•VIDEO•DIGITAL
In Business Over 50 Years.
"We Don't Just Sell It... We Use It!"

TELESCOPES•BINOCULARS•CAMERAS
We Carry: Meade • Celestron • Swarovski
Leica • Zeiss • Steiner • Fujinon • Pentax
Bausch & Lomb • Bushnell • Nikon • Canon
Catalog Available • We Ship Nationwide
http://www.berger-bros.com
Phone: (631) 264-4160 Fax: (631) 264-1007
209 Broadway (Route 110) (800) 262-4160

RETAIL SHOPS

TEXAS - Dallas 75252

THE OBSERVATORY, INC.
The Most Complete Telescope Store in Texas

TELESCOPES * MICROSCOPES * BINOCULARS

In the field set-up & instruction with every
Astronomical Telescope purchase
Astronomical Telescopes * Spotting Scopes
Binoculars & Giant Binoculars * Sky Charts
Atlases, Books * Computer Controlled Telescopes
Astronomy Software

Celestron, Meade, Orion, Tele Vue®, Geochron,
Canon, Swift, Spherical Concepts, Fujinon
Home-Dome by Technical Innovations

www.TheObservatoryInc.com
19009 Preston Rd., Suite 114 (972) 248–1450

TEXAS - San Antonio 78250

Analytical Scientific
"The Source For All Your Astronomy Needs"™

Visit our showroom and see the largest selection of telescopes in Texas. Meade, Celestron, Tele Vue®.
Telescopes, binoculars, microscopes, spotting scopes, accessories, books, charts, posters.
Science, nature and educational items.
E-Mail: asltd@analyticalsci.com
http://www.analyticalsci.com Fax: (210) 520-3344
11049 Bandera Rd. (800) 701–STAR (7827)

CANADA - Ontario - Toronto M6A 2T2

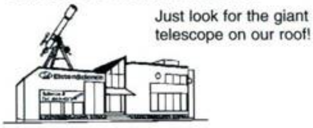
Shop on-line at www.khanscope.com

MEADE APD PRODUCTS
Our 15th Year!
NEW!!
MEADE 8" LX90

Celestron • Meade • Tele Vue® • Skywatcher
Binoculars • Spotting Scopes • Books,
Software • Low Prices
All Major Brands on Display
We Welcome trade-ins, Buy Used. Repairs & Service.
Toll Free (800) 580-7160
KHAN SCOPE CENTRE Ph. (416) 783-4140
3243 Dufferin St. Fax (416) 783-7697

CANADA - Ontario - Toronto M6A 3A4

EfstonScience
SERVING OBSERVING SINCE 1970!



Just look for the giant telescope on our roof!

MEADE APD CELESTRON

Science & Astronomy Superstore.
All major brands on display. Free Literature.
We welcome trade-ins, buy used, do service.
Dobsonians in stock: 6" - 17 1/2"
www.telescopes.ca Fax: (416) 787-5140
3350 Dufferin St. (416) 787-4581

To Subscribe to Astronomy Magazine Call 1-800-533-6644

TRAVEL

CALIFORNIA - Ridgecrest 93555

**MAYHUGH TRAVEL'S
ASTRONOMY VACATIONS**
2001 ECLIPSE LAND CRUISE
2001 ECLIPSE SAFARI
Lowest Prices Guaranteed!
http://www.mayhugh.com
cst# 2049910-40
701 Perdew Ave. (888) 412–5317

Astronomy

Retail & Travel Directory

You can affordably attract customers straight to your door with an ad in the Retail & Travel Directory!

Include your ad under one of the following categories:

- *Retail Shops*
- *Observatories*
- *Planetariums*
- *Museums*
- *Travel*
- *Star Parties & Lecture Events*

Gain respect within the amateur astronomy market by appearing in the leading astronomy magazine.

Learn more about this targeted advertising opportunity call a Classified Rep. at

1-888-558-1544 ext. 815.

Astronomy's

Classifieds

This section is open to anyone who wants to buy astronomy-related merchandise. RATES: $1.56 per word. Minimum charge is $14.00 per issue. Prepayment required. Frequency discounts available. All copy is set in standard typography. CLOSING DATE: 1st of the month, three months before the cover date (i.e., March 1st for the June issue). Send your ads to *Astronomy*, Classifieds, PO Box 1612, Waukesha, WI 53187-1612. 1-888-558-1544 ext. 815. Major credit cards accepted.

ACCESSORIES FOR SALE

Digital Setting Circle Kits for palm-size PC includes optical encoders. Altazimuth and Equatorial platform kits. TL Systems, 2184 Primrose Avenue, Vista, CA 92083. (760) 599-4219. tlsystem@ix.netcom.com or http://www.netcom.com/~tlsystem/

Visiting Hawaii? Maui Skies offers star charts, planispheres and other products to enhance star-gazing in Hawaii, plus lots of information. Visit http://www.mauiskies.com or call toll-free 877-211-8669.

PUBLICATIONS AND WEB SITES

COSMIC PERSPECTIVE, Revolutionary cosmology treatise, reveals big bang fallacy: www.webservr.com/science

Have you visited astronomy.com lately? We have added a newly-designed Classified Advertising page. Updated daily! Check it out...bookmark the page and visit often.

NEW BOOK on STAR OF BETHLEHEM, a supernova in Aquila. $10.00 postpaid. www.starofmagi.com

LODGING/TOURS/TRIPS

Join ASTRONOMY Magazine on an African Eclipse Safari. Zimbabwe - June 10 - July 1, 2001. See the splendors of the sky while on a safari! Enjoy every second of the three-minute eclipse in a cloudless African sky. You'll share the experience with lions, elephants, buffaloes, hippopotamuses, impalas, and crocodiles, and witness the fascinating effect the eclipse has on these creatures. Choose the tour that best fits your personal schedule: June 10 - June 23, 2001 or June 19 - July 1, 2001. Both magnificent excursions include a fantastic view of the eclipse in a massive sky; first rate accommodations- both in the city and on the safari; a trip to the breathtaking Victoria Falls; and so much more. Join ASTRONOMY editors for an amazing adventure of a lifetime! Space is limited-don't delay! For more information, call Specialty Tours toll free (800) 677-9412, (727) 796-7555 or e-mail gs@alspecialtytours.com

Total Solar Eclipse Africa 2001. 13-day eclipse and southern dark skies! Safari tour June 17-29 in Zambia with Victoria Falls and archaeological sites in Zimbabwe. Limited to 20 celestial adventurers. $4968 includes air from U.S. Contact Migrant Traveler at (888) 884-8477; (408) 356-7446. CST#1004042-40.

MISCELLANEOUS FOR SALE

Our Oversized 36" x 48" Solar System Primer poster is not just the same old sun and nine planets routine! This poster is crammed with slick illustrations and text. Check us out at Pennyproductions.com

ANNOUNCEMENTS/OPPORTUNITIES

Midwest Birding Symposium 2001 is winging its way to Wisconsin! Mark your calendars now for the 2001 Midwest Birding Symposium (MBS). Thursday, August 30 through Sunday, September 2, 2001. Hosted by BIRDER'S WORLD Magazine, EAGLE OPTICS, & the WISCONSIN SOCIETY FOR ORNITHOLOGY. The symposium will offer a varied menu of speakers and field trips of the state, Green Bay is surrounded by wetlands that vary from Lake Michigan shoreline to cattail marsh and sedge meadow. The area lies along major pathways for fall migrants. The theme of Wetlands and Wetland Species will ring through the weekend of activities that will include birding field trips, visits to nature centers , museums and bay cruises. The roster of renowned keynote speakers continues to expand. The symposium will be held at the Regency Suites Conference Center in downtown Green Bay. For accommodations, call (800) 236-3330 and request the special MBS room rate. The Green Bay Area Visitors and Convention Bureau can be reached at (920) 494-9507 for lists of alternative lodging. Sponsors to date include Swift Instruments, Leica Sports Optics, Swarovski Optics, the Green Bay Area Visitor and Convention Bureau, and the Mosquito Hill Nature Center. Additional information can be found on the BIRDER'S WORLD Web site: www.birdersworld.com. For questions or registration, please contact Bill Hubert at (800) 558-1544 ext. 236; by fax at (262) 798-6592 or by e-mail at bhubert@kalmbach.com.

TELESCOPES FOR SALE

Meade 8 inch LX50. $850, Magellan II $450, 416XTCCD $850. Call (860) 633-9345.

Telescopes and binoculars: Check our Web Site or call for a wide range for Konus reflectors, refractors, binoculars. Web: http://www.owlservices.com E-mail: owl1@postoffice.ptd.net phone: 1-888-OWL-WARE, (610) 837-1917, 10-5 M-F Eastern Time. Display in Allentown, Pennsylvania. Good prices, high quality!

TELESCOPES WANTED

Wanted: used telescopes and accessories. Contact Gary Hand, 24045 Sugarcane Ln., Gaithersburg, MD 20882. (301) 253-5046.

It's like a dream come true…

FREE advertising!

Now featuring a free listing on the internet when you purchase a classified word ad in ***Astronomy*** *Magazine!*

Contact a Classified Representative at 1-888-558-1544, ext. 487

UPDATED DAILY!

See the splendors of the sky while on safari!

Solar eclipse 2001 Zimbabwe, AFRICA

June 11 - June 22, 2001 Or June 19 - June 30, 2001

Enjoy every second of the three-minute eclipse in a cloudless African sky. You'll have the opportunity to see exotic safari animals such as lions, elephants, cheetahs, cape buffaloes, hippopotamuses, impalas, and crocodiles! Join ***Astronomy*** editors for an amazing adventure of a lifetime!

Choose whichever tour best accommodates your personal schedule. Both magnificent excursions include:

- A fantastic view of the eclipse in a massive, clear sky.
- First-rate accommodations both in the city and on safari.
- A trip to the breathtaking Victoria Falls.
- Plus so much more!

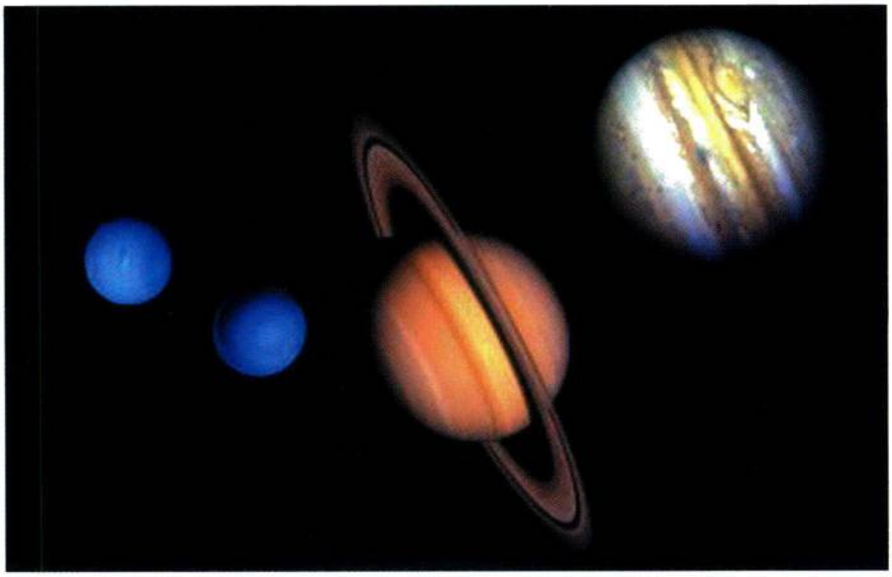
Space is limited, so call today!

(800) 677-9412

www.a1specialtytours.com

LOOKING AHEAD
MARCH

Houston, Texas is the location for the **32nd Lunar and Planetary Science Conference** being held **March 12–16**. Sponsored by the National Aeronautics and Space Administration, the Lunar and Planetary Institute, and NASA's Johnson Space Center, presentations will include summaries of the newest research results, a special session addressing observations of Europa's surface and subsurface, and a panel discussion entitled, "The Societal Connections of Planetary Exploration and the Search for Life Elsewhere." Technical sessions will be held at the Johnson Space Center and at the University of Houston – Clear Lake. On Sunday, **March 11**, LPI will offer a **preconference workshop** for scientists interested in becoming more involved in education and public outreach. For registration information, contact the LPI Publications and Program Services Department, (281) 486–2142; fax, (281) 486–2125; e-mail, tanner@lpi.usra.edu; website, http://www.lpi.usra.edu/meetings/lpsc2001/.


NASA

The 32nd Lunar and Planetary Science Conference will be held in Houston, Texas, March 12–16.

THROUGH MAY 13
Star Struck: One Thousand Years of the Art and Science of Astronomy
The Huntington Library, San Marino, California. Rare books and manuscripts from the Huntington's collection will be showcased in this exhibition, including works by Ptolemy, Galileo, Copernicus, Newton, Kepler, Hubble, Einstein, and others. Also featured will be a moon rock from NASA, medieval manuscripts from the J. Paul Getty Museum, and deep-space photos from JPL. For more information, call the Huntington Library at (626) 405–2142, or visit their website at http://www.huntington.org.

MARCH 23
Adler Astronomy Lectures
Adler Planetarium and Astronomy Museum, Chicago, Illinois. **Fred Raab** of the LIGO Hanford Observatory will discuss **"LIGO: Portal to Space-Time."** For more information, contact (312) 922–STAR; or view the Adler website, http://www.adlerplanetarium.org.

MARCH 17–26
Astronomy's Northern Lights Tour of Alaska
Join *Astronomy* on this watch for the magical northern lights in the heart of Alaska. For more information, call Specialty Tours at (800) 677–9412 or (727) 796–7555; or e-mail, gs@a1specialtytours.com.

MARCH 22–24
Star Party
Sponsored by the Astronomical Society of the Palm Beaches. For more information, contact the Society at P.O. Box 30023, Palm Beach Gardens, FL 33420; club hotline, (561) 471–0476; or e-mail Cal Waters at calw357@aol.com.

MARCH 22–25
Kisatchie Star Party
Kisatchie National Forest, in central Louisiana. Sponsored by the Baton Rouge Astronomical Society. For more information, contact Don Weinell, 1605 South Park Avenue, Gonzales, LA 70737; e-mail, weinell@eatel.net; website, www.eatel.net/~weinell.

MARCH 23–26
South Pacific Star Party
Wiruna, near Ilford, New South Wales, Australia. Hosted by the Astronomical Society of NSW, this is the largest amateur astronomy event of its kind in Australia. For more information, contact Les Sara, e-mail, Secretary@asnsw.com; website, http://www.asnsw.com.

MARCH 31
Queensland Astronomy Education Conference
Queensland, Australia. Contact Paul Floyd, e-mail, ssemps@ozemail.com.au; website, http://www.ozemail.com.au/~ssemps/confer/index.html.

APRIL 20–22
Spring Central Texas Star Party
Canyon of the Eagles Lodge and Nature Park near Burnet, Texas. For information and reservations at the park hotel, call (800) 977–0081 or check online at http://www.canyonoftheeagles.com. For more information, contact the Austin Astronomical Society, P.O. Box 12831, Austin, TX 78711-2831; (512) 252–2966; e-mail, anne@hadkins.com; website, http://www.main.org/aas/activity.html#centex. ■

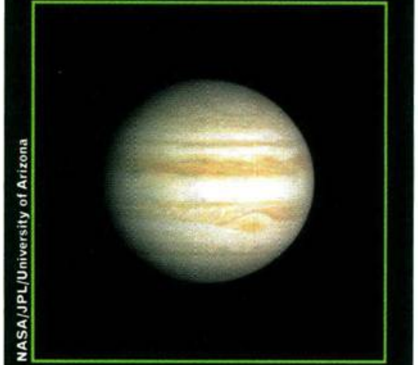
CONTACT

Please submit club announcements four months in advance to Looking Ahead, *Astronomy*, P.O. Box 1612, Waukesha, WI 53187, or to tconley@astronomy.com. Look for *additional events at http://www.*astronomy.com.

AD INDEX

ASM Products	109
Adorama	74, 75
Any Cosmic Night	106
Astro-Physics	106
Astronomics	92, 93
Atomic Time	91
Bethany Sciences	107
Camcor, Inc.	103
Celestron International	25, 104, 105
Chabot Observatory	101
Davis Instruments	102
Discovery Telescopes, Inc	91
Eagle Optics	99
East African Travel Consultant	109
Edmund Scientific Company	33
Edward R Hamilton Bookseller	107
eHobbies.com, Inc.	18, 19
F C Meichsner Company	99
Focus Camera	34, 35
Glatter, Howard	107
Gould Precision Optics	109
Hardin Optical Co.	99, 108
Into The Wind/The Kite Source	107
JMB, Inc	99
Jim's Mobile Industries	27
Kalmbach Publishing Co.	31, 63, 95, 107, 109, 111, 113
Kendrick Astro Instruments	63
Krollkraft	106
Le Sueur Manufacturing Co.	33
Lumicon	36, 37
Mag One Instruments	106
Marketplace Pages	106, 107, 108, 109
Meade Instruments Corp.	2, 3, 7, 8, 9, 10, 11, 122
Meade Dealer Pages	12, 13
Meta Reasearch	101
Minerva Press	106
Mountain Skies Astronomical Society	109
National Academy Press	101
New England Meteoritical	106
New Mexico Skies	107
Newport Glass Works	107
Northeast Astronomy Forum & Telescope Show	95
Novaspace	108
Oceanside Photo & Telescope	16
Orion Telescopes & Binoculars	23, 88, 89, 121
Outer Edge Expeditions	107
Pocono West Optics	29
Rainbow Symphony	107
Remote River Expeditions	109
Retail & Travel Directory	110
Rivers Camera Shop	33
Rome Telescope Company	108
SCS Astro	108
Sac Imaging Systems	108
Santa Barbara Instrument Group	58
Science Connection, Inc.	108
Scope City	103
Scopequipment	109
ScopeTronix	106
Shutan Camera & Video	97
Sirius Observatories	108
Skytent International	108
Starizona	16
Star Hill Inn	108
Star Tek Industries	107
Starry Night	21
Starsafaris.com	15
Starsplitter Telescopes	109
Sure Travel	109
T & T Binocular Mounts & Beyond LLC	106
Tech 2000	109
Technical Innovations	102
The Teaching Company	17
The Telescope Store	103
Thousand Oaks Optical	33
Travel Quest	108
University Optics, Inc.	109
The Weather Warehouse	106
Wholesale Optics	63

NEXT month in Astronomy April 2001


NASA/JPL/University of Arizona

CASSINI ROUNDS JUPITER

A sophisticated spacecraft sped by the giant planet as 2000 drew to a close, returning a boatload of spectacular images to Earthbound scientists.

GET THE HOLE STORY

Black holes won't swallow Earth and they don't suck in everything for light-years around, but these misconceptions seem dull when compared with reality.

BLAZING INTO ORBIT

While Laika, Mushka, and Gordo don't have the name recognition of Gagarin, Shepard, and Glenn, those pioneering animals paved the way for human spaceflight.

SOLVING THE STARS

In a moment of inspiration, Nobel Prize winner Hans Bethe figured out the nuclear reactions that make stars shine.

To get your copy of the April issue, visit your local hobby shop, bookstore, or newsstand, or call

1-800-533-6644

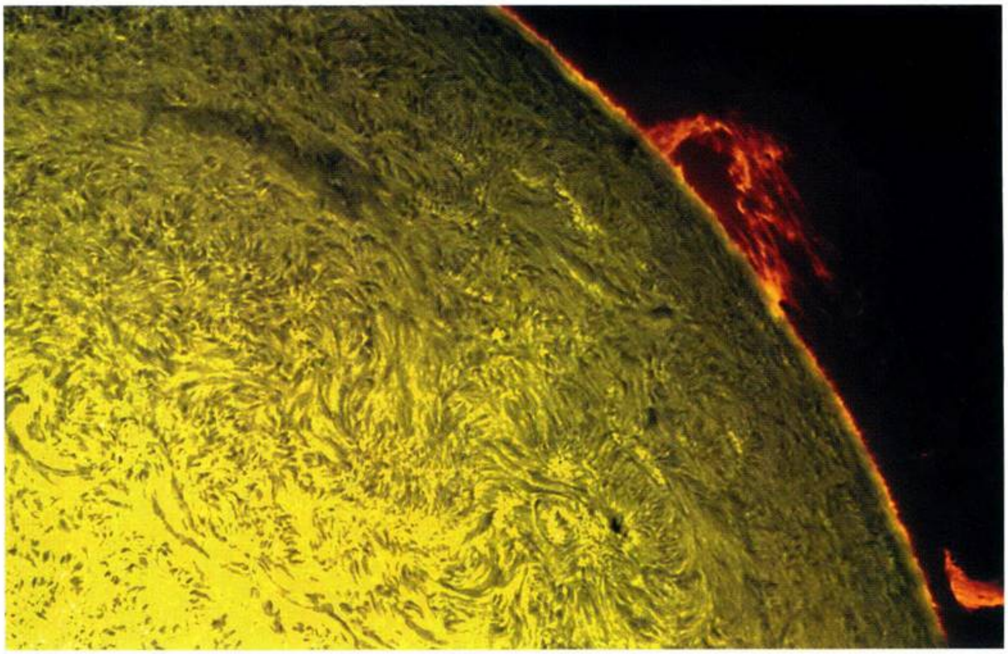
Kalmbach Publishing Co., P.O. Box 1612,
Waukesha, WI 53187-1612

Visit us at

Astronomy.com

HOT SHOTS

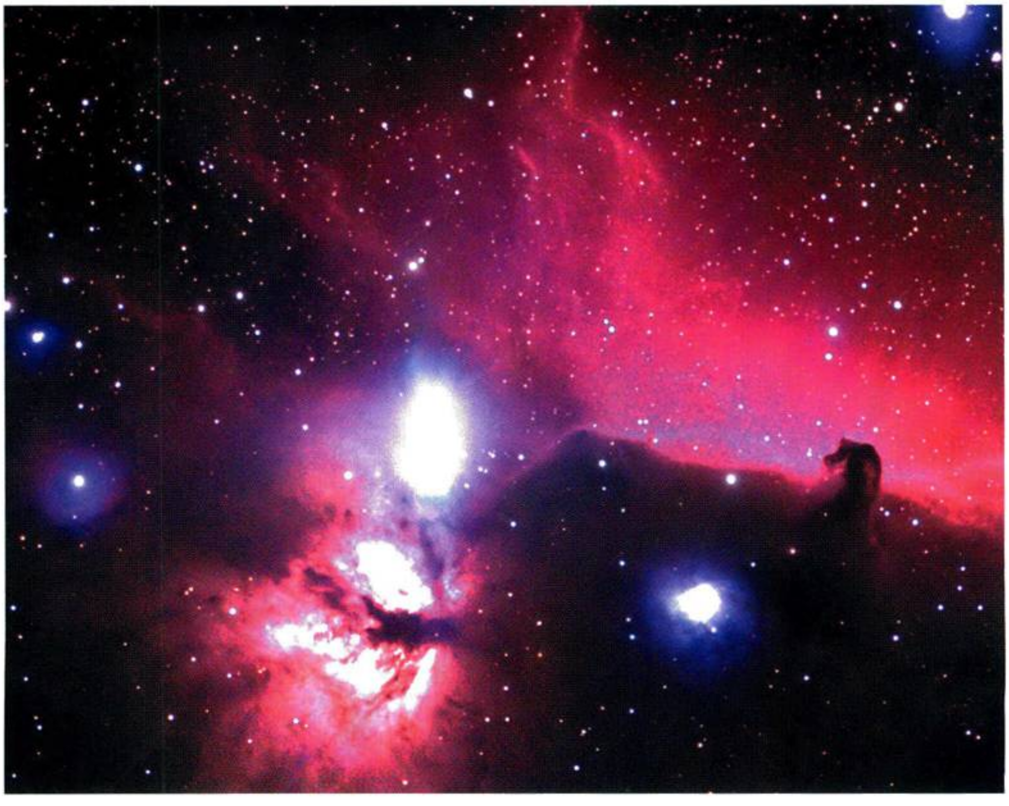
A collection of your images and observations



Solar Prominences in H-α Light

JACK NEWTON

(5-inch apochromatic refractor at f/25, H-α filter, Pictor 1616XTE CCD camera, taken November 24, 2000)



The Horsehead Nebula (B33) in Orion

ROBERT GENDLER

(4-inch f/5 refractor, ST-8E CCD camera, composite of four exposures)

ASTRONOMICAL FUN

Finding Camp Astronomy

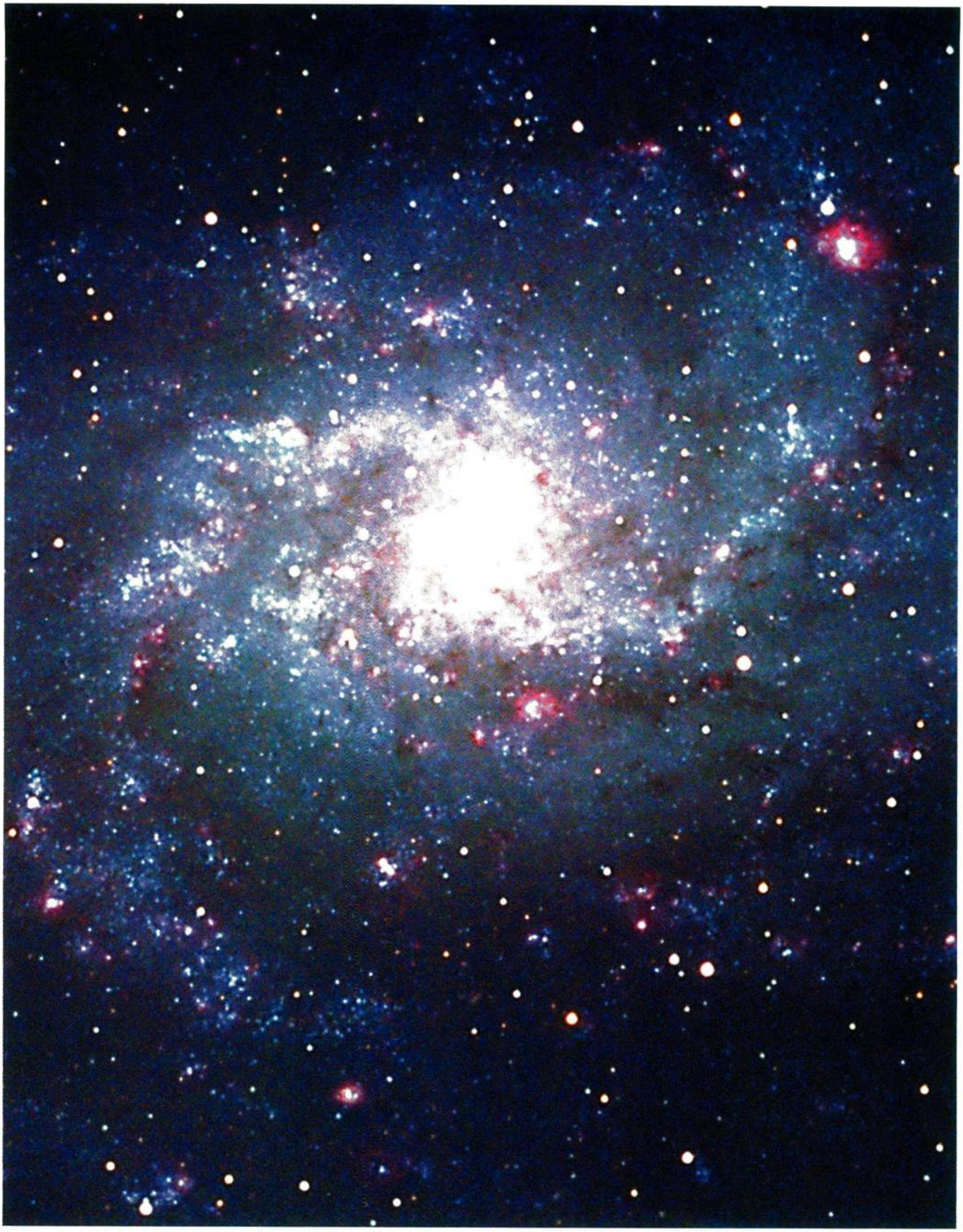
Meteorites, star trails, and adventure fill the hours at astronomy camp.

by Carol Latta

▶ I got this thing as a Christmas present, unsure of what it would turn out to be. A trip to "astronomy camp"? Visions of boot camp surged through my mind, but after a moment more pleasant things occurred to my imagination. If only I could have envisioned how much fun this trip would end up being.

The whole thing was made possible by the dedication of Bob Wooley, a geologist-astronomer and former Navy F14 pilot who has set up an amazing facility near Flagstaff, Arizona. His "Astronomical Adventures" is built near the middle of a 90,000-acre ranch; the surrounding area features mostly clear and dark skies. Wooley has established a base camp with a variety of telescopes so that amateur astronomers can come to the ranch and spend a week doing astronomy, making for a unique and unforgettable experience.

The program features as much touring of our own planet as it does touring the night sky. On the first day, Bob met me at Meteor Crater near Winslow. Here Gene Shoemaker created the field of impact geology when he upset the apple



The Pinwheel Galaxy (M33) in Triangulum

JAMES R. FOSTER

(13.1-inch Cassegrain scope, hypered PPF film, composite of 80-minute red, 70-minute green, and 70-minute blue exposures) cart on the conventional view that the crater was formed by underground magma floes. The result of an enormous impact some 50,000 years ago, the crater is now regarded as the best preserved large impact site anywhere on Earth.

Although I was the only student on the first day (three others joined us later), Bob pulled out all the stops. Pausing with the crater in view four miles off, he recreated the incoming meteorite and the crater's birth. We approached the rim, stopped to scratch "$KE = \frac{1}{2}MV^2$" in the dust, and hiked the rim, visualizing the immense power of the impact and explosion.

Using a magnet, we collected micrometeorites from the scattered debris. Bob explained how the discovery of inverted strata was applied to Apollo moon rock collection techniques. Finally, we pored over the museum exhibits, deeply satisfied with the day.

Back at the ranch, 30 miles outside Flagstaff, we met the rest of our student group: an astronomy professor, a college student, and another amateur astronomer. The chemistry was ideal, generating great conversation. The ranch had its own charm: a welcoming sign reads "5 mph: watch for dogs, kids, astronomers, chickens, and cowboys." Driving dirt roads into the facility, we dodged elk, antelope, and jackrabbits.

The program's many telescopes range from a 4-inch refractor to a 36-inch Dobsonian. On a particularly dark night, we wheeled out a 30-inch Dob. While Bob found each object for viewing, the students became a ladder brigade to position the 12' staircase. When we

A Multicolored Aurora Hangs over Skagway, Alaska

MICHAEL KLENSCH

(24mm lens at f/2.8, Fuji 200 ISO film, 20-second exposure taken February 11, 2000)

finally peered into the eyepiece, the wait was deemed worthwhile. Exclaiming "Wow!" along with more colorful expressions, we witnessed sharp, detailed views of the Sombrero and Whirlpool galaxies, the Veil Nebula, the Omega, Eagle, Trifid, Lagoon, Dumbbell, and others.

The stars in the clusters M13 and Omega Centauri were uncountable. Many other objects were observed, showing plenty of mind-blowing detail, giving us the best deep-sky observing we had experienced.

We spent the remainder of our days studying rock formations around Sedona, volcanoes at Sunset Crater, and time-lapse geology at the Grand Canyon. At the U.S. Geological Survey facility in Flagstaff, we used 3-D photos to study the topographic features of planets and moons. We learned that Mars' mighty Olympus Mons, the largest volcano in the solar system, owes its great height of 82,000 feet to a lack of plate tectonics. To climb it would mean merely taking a long walk up its gentle slope.

In retrospect, our week at Astronomical Adventures was exhilarating and enjoyable. I could have used a little less geology and a little more astronomy, but altogether it was wonderful.

My hope had been to make a quantum leap in knowledge and experience while having a record amount of serious fun. Thanks to the enthusiasm of Bob Wooley and my fellow students, my hope became a reality.

Carol Latta is an enthusiastic amateur astronomer living in Hilton, New York.

Spiral Galaxy NGC 5371 in Canes Venatici

AL KELLY

(32-inch f/4 reflector, Cookbook 245 CCD camera, composite image)

Comet Hyakutake (C/1996 B2)

JAMES R. FOSTER

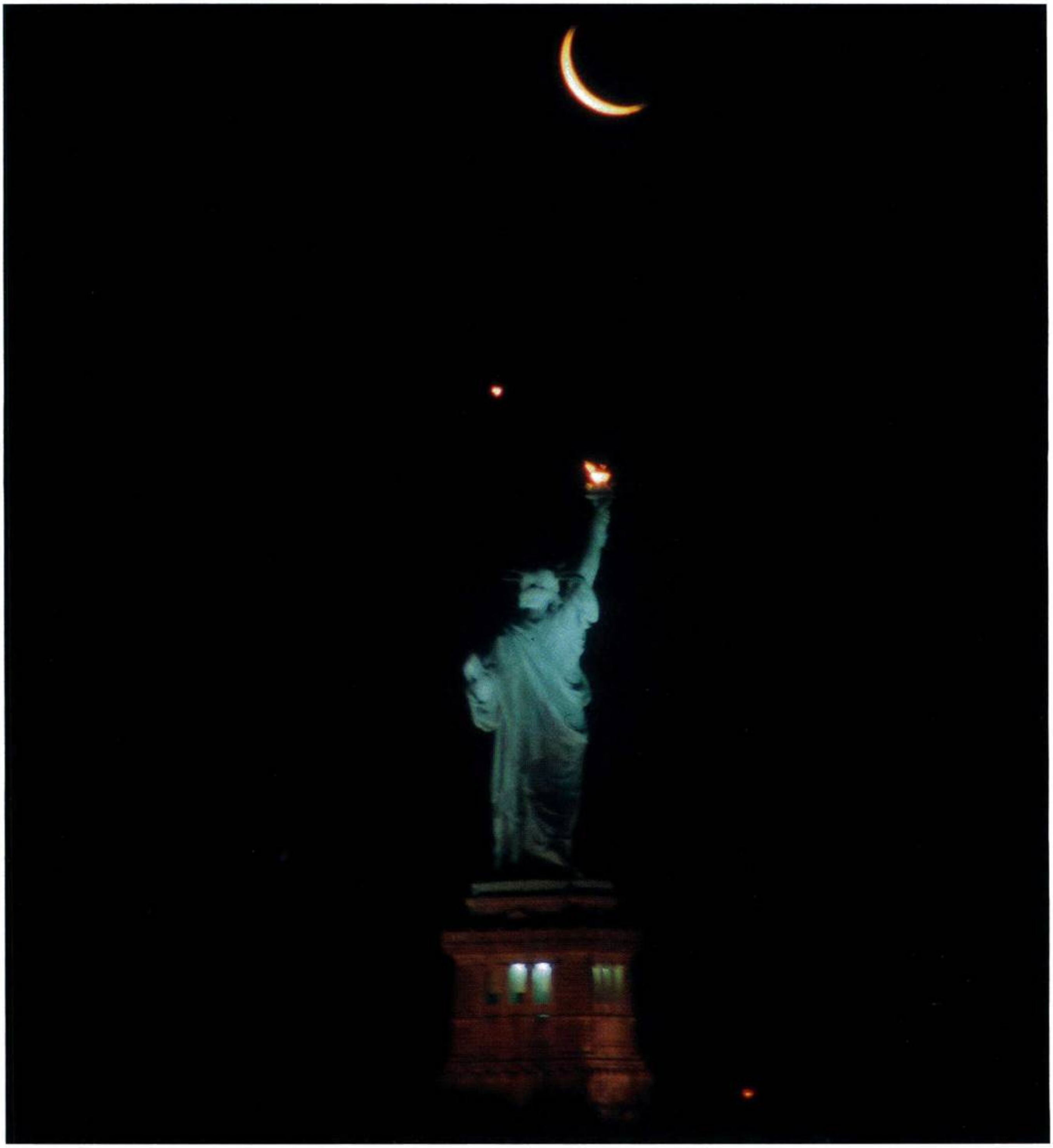
(4-inch f/5 refractor, hypered Fuji HG-400 film, 20-minute exposure)

Orion Trails over Manitoulin Island, Ontario

MARK OLDFIELD

(28mm lens at f/2.8, Kodak ISO 100 film, 90-minute exposure taken September 4, 2000)

This month's best astrophoto



The Moon and Venus Hover over Lady Liberty

ANTHONY DIFILIPPI AND MIKE O'MELIA

(105mm lens at f/2.5, 3-second exposure taken February 2, 2000)

Venus, the "morning star," put on a beautiful show during the first weeks of last year and, as February opened, paired *nicely* with the moon. Two New Yorkers caught the pairing amidst Auguste Bartholdi's classic 1875 statue on Ellis Island.

Astrophotography to the Max!

These premium scopes were designed with astrophotography in mind. With any one of them you can capture gorgeous deep-sky shots of magazine-cover quality!

Horsehead Nebula region taken by Marco Lorenzi with an R200SS reflector with coma corrector.

VX102-ED f/6.5 Refractor

S&T called the VX102-ED "especially attractive for any-one on a budget wanting to get into astrophotography."

From $1499*

R200SS f/4 Reflector

Ultra-fast 200mm f/4 parabolic optics and a wonderful 2" focuser give this premium Newtonian fantastic imaging prowess.

From $1099*

New!

VX114-ED f/5.3 Refractor

With aperture to burn and a focal length of just 600mm, this compact "apo" captures truly enchanting wide-field starscapes.

From $2199*

*** Price of optical tube assembly**

ORION
TELESCOPES & BINOCULARS
telescope.com

Everything for the Amateur Astronomer–Delivered Direct

Immediate Delivery!
MEADE
LX90
MEADE LX90 EMC
MEADE

Now you can buy the telescope of a lifetime at a price you probably never thought possible.

The Meade 8" LX90, with diffraction-limited Meade optics in an Autostar™ computer-controlled telescope system, includes capabilities not available on other brands of 8" Schmidt-Cassegrains costing hundreds of dollars more. Incorporating the optical system and coatings of the 8" LX200, and with 5 arc-minute pointing precision in the GO TO mode, the LX90 is an instrument fully qualified for long-exposure CCD imaging and astrophotography as well as for other advanced photo-visual applications.

Special LX90 features include: (a) a die-cast-aluminum *double-tine* fork mount that rigidly supports the optical tube in all sky orientations; (b) *worm gears* of 4.9"-diameter on both telescope axes for smooth sidereal-rate tracking of celestial objects as well as precise guiding corrections during long-exposure imaging; (c) a rigid chromed-steel variable-height field tripod — *the same tripod provided with Meade LX200 models.*

Autostar Computer Controller: The LX90's *standard-equipment* Autostar controller permits an incredible array of telescope features: • *Automatic GO TO capability* at 6.5°/sec on both axes, simultaneously, to 30,223 database objects, including: 13,235 deep-sky objects — the complete Messier, Caldwell, IC, and NGC catalogs; 16,888 stars sorted by name and SAO catalog numbers; 8 major planets from Mercury to Pluto; the Moon; 26 asteroids; 15 comets; 50 Earth satellites; plus 200 memory locations for user-defined objects. • *Automatic GO TO capability* to *any* object of known R.A. and Declination. Plus hundreds of special event menus, guided tours, utility functions, and telescope status options. • *Nine selectable slew speeds:* 6.5°/sec, 3°/sec, and 1.5°/sec, as well as 128x, 64x, 16x, 8x, 2x, and 1x sidereal. • *Control of the telescope* through your personal computer. (Requires optional #505 Connector Cable Set.) • *Fast alignment of the telescope* in either equatorial or altazimuth modes using any of three alignment functions, including the Meade-proprietary Easy Align*. • *Unlike the hand controllers* included with competing 5" and 8" SCT's, *Autostar is fully upgradeable over the Internet*: the observer can add the positions of new comets, update the positions of Earth satellites, even add new software as it becomes available.

* Patent pending.

Cordless Operation: The LX 90 is powered at 12 volts DC provided by (user-supplied) C-cell batteries which fit neatly into the telescope's drive base.

Meade 8" LX90 Schmidt-Cassegrain Telescope. Complete as shown:

$1695

SPECIFICATIONS: 8" LX90 — Each complete telescope includes 8" f/10 Schmidt-Cassegrain optical tube assembly with EMC super multi-coatings; double-tine fork mount with dual-axis 4.9" worm gears and control panel; electric slow-motion controls on both axes; Autostar hand controller with digital readout display, 9-speed drive controls on both axes, and GO TO controller; 30,223-object onboard celestial software library; internal battery port accepts 8 (user-supplied) C-cells (optional 25 ft. cords permit powering from either 12vDC auto cigarette lighter plug or from 115vAC home outlet); 8 x 50mm viewfinder; 1.25" diagonal prism; Series 4000 Super Plössl 26mm eyepiece; standard field tripod; operating instructions. **$1695.** Packing/shipping in the 48 states: $95.

2001 Meade 126-page General Catalog!

Call, write or fax for your free copy.

ADVANCED PRODUCTS DIVISION

Meade Instruments Corporation

The largest-selling telescopes in the world. ☐ *A NASDAQ® company.*
6001 Oak Canyon, Irvine, California 92618 ☐ (949) 451-1450
FAX: (949) 451-1460 ☐ *www.meade.com*

© 2001